Operator's Manual

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Revised Manual Pages

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Reference Guide

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1. Introduction

1.1 Manual Outline

The Reference Guide is part of the Elecsys® 1010 Operator's Manual, which also includes the Software Guide, Tutorial Guide, User's Guide and Short Guide.

The Reference Guide gives a comprehensive insight into the technical/theoretical operation of the Elecsys 1010 analyzer.

Chapter 1. Introduction

This chapter introduces the analyzer and describes the packaging concept for reagents, calibrators and controls. Important safety instructions are also provided in this section.

Chapter 2. System Description

This chapter describes in detail the individual components of the analyzer, their tasks and technical data.

Chapter 3. Functional Sequence of Analysis

This chapter describes the individual stages of the immunological analysis process on the analyzer.

Chapter 4. ECL Technology

This chapter describes the fundamental principle of the electrochemiluminescent process.

Chapter 5. Test Principles

This chapter describes the principles of the various immunoassay processes.

Chapter 6. Calibration

This chapter describes the validation criteria in theory, as well as the various calibration methods used on Elecsys 1010.

Chapter 7. Glossary

This chapter provides definitions of commonly used terms.

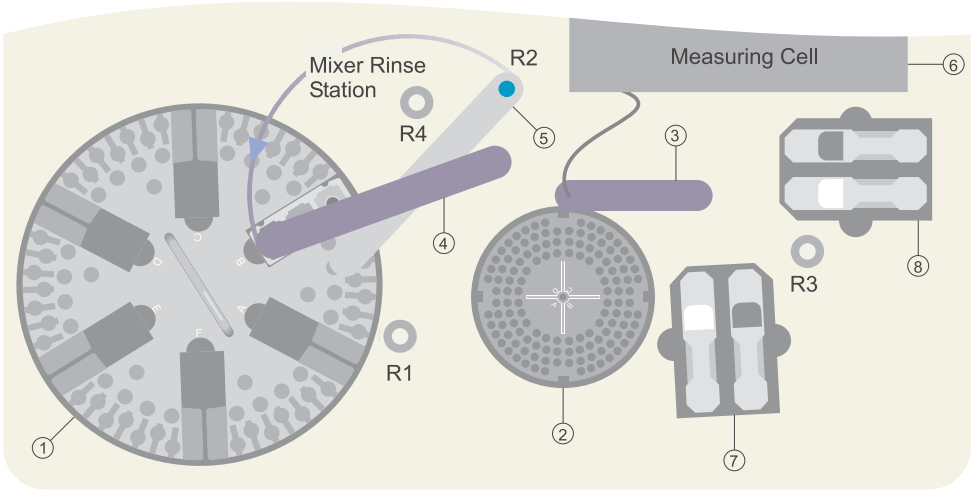
1.2 The Elecsys 1010 Analyzer

The Elecsys 1010 analyzer is a fully automatic, run-oriented analyzer system for determination of immunological tests using the ECL/Origen electrochemiluminescent process. All components and reagents for routine analysis are integrated in or on the analyzer.

Operation of the analyzer is simple and intuitive. The reagents are stable and can be directly loaded onto the analyzer. The consistent use of bar-coded reagents greatly reduces the need for time-consuming manual entries in the daily routine. Additional automation can be achieved by connecting a laboratory EDP (host) system.

You can use serum and plasma samples in primary tubes, Hitachi standard cups, microcups or cups on primary sample tubes. Bar-coded sample tubes are recognized. Two STAT positions for STAT samples are also available.

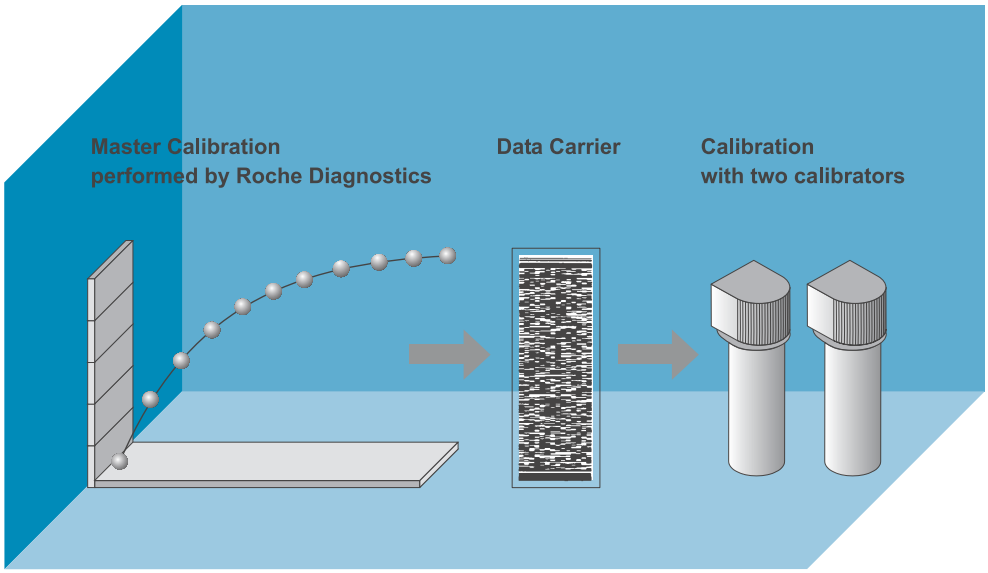
Results are produced either qualitatively or quantitatively depending on the test. The typical test throughput is approximately 50 results per hour.



①	Sample/reagent disk
②	Incubator
③	Sipper arm
④ + ⑤	Sample/reagent arm (S/R probe and mixer)
⑥	Detection unit (measuring cell)
⑦ + ⑧	Positions for ProCell and CleanCell bottles
R1/R2	S/R probe rinse station
R3	Sipper probe rinse station
R4	Mixer rinse station

1.3 Reagents, Calibrators and Controls

The reagent packs have a special 2D (two dimensional) bar code, which allows fully automatic registration and management of reagent information. Manual input or additional monitoring is not necessary. The ready-to-use, liquid reagents are loaded into one of the six positions on the sample/reagent disk. Reagents are available for analysis after their bar codes have been scanned.



The handling of calibrators and Roche Diagnostics controls corresponds to that of reagents. Most calibrators are ready-to-use. Lyophilized controls and some calibrators must be prepared and transferred into the appropriate container. Calibrator and control information is stored on 2D bar code cards (see Chapter 1.3.7, Calibrator and Control Bar Code Cards).

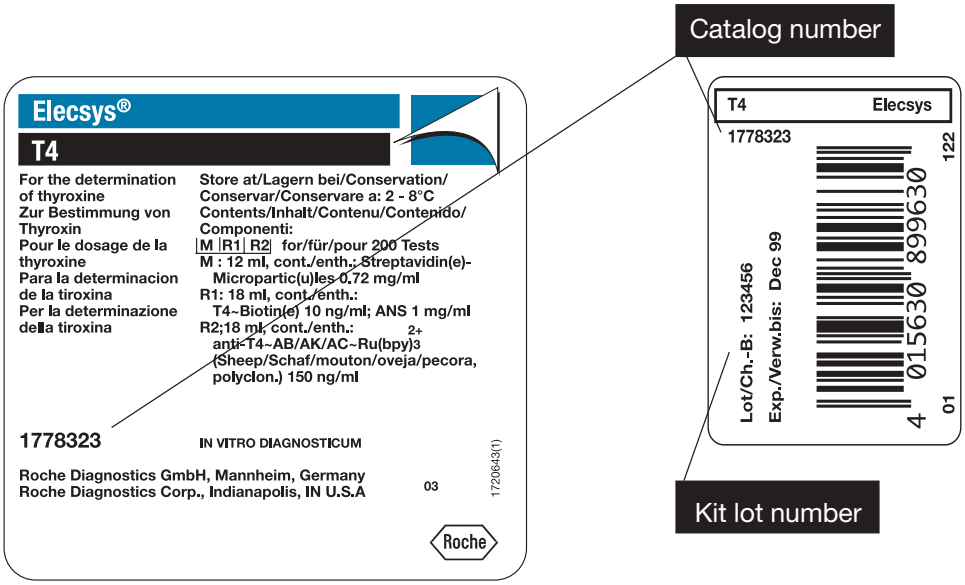
1.3.1 Reagent Kits (Reagent Packs)

Reagent packs are ready-to-use and incorporate three bottles connected to each other:

- The white bottle with a transparent lid contains suspended magnetic microparticles that act as the carrier material of the ruthenium-labeled complex during measurement.
- The black bottle with a gray lid contains R1.
- The black bottle with a black lid contains R2.

The test application, calibration data, control information, sample and reagent volumes, as well as special measurement conditions are contained in the reagent bar code and therefore do not have to be entered separately by the operator.

The following are examples of typical box labels for an Elecsys reagent kit. The large label contains the intended use statement, storage temperature, contents and catalog number of the kit. The smaller side box label contains the lot and expiration date of the kit as well as a bar code number. This bar code number is used for tracking purposes and is not used by the analyzer.



1.3.2 Package Insert

Each reagent kit includes a package insert. This insert contains information required to perform the assay. Detailed information is contained in the product information sheet supplied separately.

1.3.3 Product Information Sheet

Each assay applied to this analyzer has a product information sheet that provides general information about the assay. Data contained in the product information sheets is more detailed than what is in the package insert. Instrument settings are encoded in reagent bar codes and not entered by the operator. This type of information, such as sample volume, reagent volume, etc., are found in the overview section of the product information sheet.

Product information sheets can be obtained from Roche Diagnostics as required.

1.3.4 Calibrator and Control Kits

In most cases, calibrators and controls for Elecsys reagents come packaged separately.

Each kit contains either bar-coded calibrator or bar-coded control vials ready for use on the analyzer. Most calibrators are in ready-to-use liquid form and require no further action other than to place them on the sample/ reagent disk when a calibration is necessary.

A few of the calibrators and controls are lyophilized in glass bottles and must be reconstituted before being transferred into plastic bar coded-labeled vials. (Empty bar coded-labeled vials are packaged in these kits with lyophilized calibrators and controls.) Reconstituted calibrators and controls can be stored in the plastic vials after transfer.

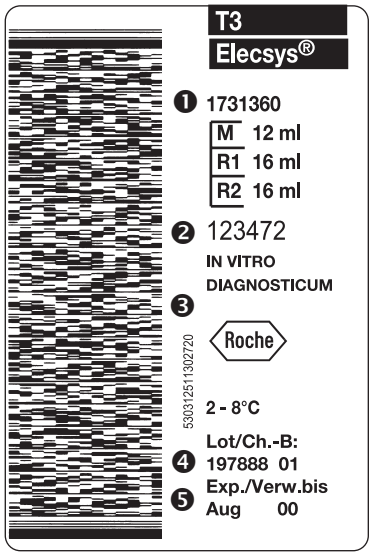
Calibrators and controls also have color-coded caps to assist you in identification. A white cap is a level one calibrator/control and a black cap is a level two calibrator/control. In the course of the year 2000, black and white color-coded caps for controls will be phased out in favor of beige/light brown (level one) and caramel/dark brown (level two).

Calibrator and control bar code cards are packed with calibrator and control kits, respectively (see Chapter 1.3.7, Calibrator and Control Bar Code Cards).

1.3.5 Reagent Bar Code Labels

Reagent packs have a bar code label that contains information required to run the assay. This information includes:

- test number
- lot number
- master calibration curve parameters (e.g. Rodbard parameters)
- instrument settings
- calibrator lot numbers and target values
- expiration date
- calibration frequency



The following information can be identified on each reagent bar code label:

❶ kit catalog number
❷ reagent pack number
❸ reagent bar code number
❹ kit lot number
❺ expiration date.

The reagent bar code label is in a new format. The new symbology utilizes portable data files (PDF) and is called PDF417. Traditional linear bar codes serve as a link to a database that contains the appropriate information. PDF417 is a two dimensional (2D), stacked bar code that contains an actual entire data record. The large amount of data that can be encoded allows all instrument settings to be included, as well as the master calibration curve and additional information for the assay. It is from this master curve and from the operator 2-point calibration that the analyzer derives the update of the master calibration curve. For further information, refer to Chapter 6, Calibration.

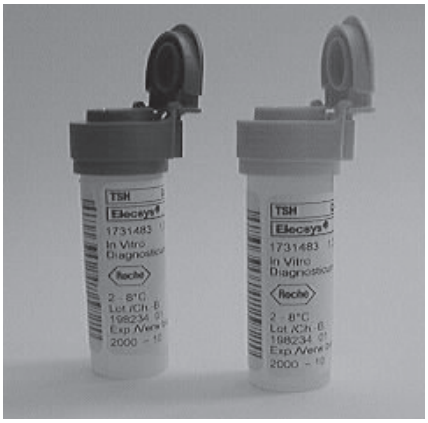
"Every PDF417 symbol (bar code) contains two error detection codewords that are used like the check digit in linear bar code symbologies to detect decode errors and verify that all data have been read and decoded accurately. Additionally, PDF417 provides error correction in the event that portions of symbol have been damaged, destroyed or are unreadable."[1]

It is a combination of this error detection and error correction that ensures a reliable bar code. If the bar code cannot be read and the reagent lot has been previously used by the analyzer, the 15-digit number can be entered manually in the software.

1. Itkin S, Martell J. *A PDF417 Primer: A Guide to Understanding Second Generation Bar Codes and Portable Data Files*. Bohemia, NY: Symbol Technologies, Inc; 1992:17-18.

1.3.6 Calibrator and Control Bar Code Labels

Each calibrator and control bottle has a traditional linear bar code label that contains an identifier to link it to information encoded in the reagent bar code label and the calibrator or the control bar code card (see Chapters 1.3.5 and 1.3.7).



1.3.7 Calibrator and Control Bar Code Cards

Each calibrator and control kit comes with one or two 2D bar code cards. The following information is included but not limited to:

- test number
- calibrator/control lot number
- control code (e.g., PCU1) (control card only)
- lot number of the calibrator/control bar code label
- information about which calibrator is to be used and the number of determinations (calibrator card only)
- target values
- control ranges (control card only)
- expiration date.

Roche Diagnostics produces a factory master calibration for each calibration lot. The results are encoded into the corresponding reagent bar code. Scan the new bar code card when a new lot of calibrators or controls is used.

1.4 Potential Hazards and Safety Precautions

1.4.1 Safety Notes

To protect yourself from potential hazards, you must review all safety precautions and regulations concerning the handling of materials and the system's electrical and mechanical components.

The important safety notes in this manual are listed and classified below. Make yourself acquainted with the following visual cues and icons:

WARNING
Warning messages contain information which, if not followed, could cause serious personal injury and/or damage to the analyzer.

CAUTION
Caution messages contain information which, if not observed, could result in loss of data and/or damage to the analyzer.

Note
Notes contain important information about a topic in the text.

Electricity

To avoid an electric shock DO NOT attempt to open the instrument panels and work in any electronic compartment.

Chemical

The operator is responsible for taking all necessary precautions against hazard associated with the use of clinical laboratory chemicals. Specific recommendations for each reagent used on the analyzer are found on the box label, package insert or product information sheet for each chemistry. Material Safety Data Sheets (MSDS) are available for Roche Diagnostics reagents.

Immediately remove any reagent spillage from the instrument.

Mechanical

As with any mechanical system, certain precautions must be taken when operating the instrument. DO NOT wear loose garments or jewelry that could catch in moving mechanisms. DO NOT put your hand into the pathway of any moving parts while the analyzer is operating. Operate the instrument with the cover down. DO NOT attempt mechanical repairs unless the instrument is in Stand-by or OFF.

Biohazardous Materials

As with all in vitro diagnostic equipment, patient samples and serum-based quality control (QC) products that are assayed on this system, as well as all waste from the waste container, should be treated as potentially biohazardous. All materials and mechanical components associated with the sampling and waste system should be handled according to your facility's biohazard procedure. Use the personal protective equipment recommended by your facility when handling any of these components.

Safety Precautions During Operation

Samples

1. Treat all samples as potential biohazards. If sample spills on the instrument, use correct personal protective equipment (PPE-gloves, lab coat, etc.) and wipe off the spillage immediately.
2. Make sure that the sample does not contain any fibrin, dust or other insoluble contaminants. If insoluble contaminants are contained in the sample, correct measuring values may not be obtained.

Waste Solution and Solid Wastes

1. Avoid direct contact with waste solution and/or solid wastes. Both should be handled as potential biohazards.
2. Dispose of waste solution and/or solid wastes according to the relevant governmental regulations.
3. Consult the reagent manufacturer for information on the concentrations of heavy metals and other toxic constituents in each reagent.

4.

   WARNING
   Do not add bleach to the liquid waste container. Bleach combined with the contents of the liquid waste could cause potentially harmful fumes.

Biohazardous Parts

1. Avoid direct contact with the sample/reagent probe, sipper probe and rinse station. Treat these areas as potentially biohazardous.

Reagents

1. Avoid direct contact with reagents. Direct contact may result in skin irritation or damage. Refer to the reagent kit box labels or package insert for specific instructions.
2. Avoid direct contact with CleanCell. Direct contact may result in skin irritation or damage. Refer to the CleanCell box label or package insert for specific instructions.

Additional Precautions

Flammables

Avoid using dangerous flammables near the instrument. Fire or explosion may be caused by naked flames.

Accuracy/Precision of Measured Results

For proper use of the instrument, measure control samples and monitor the instrument during operation.

An incorrectly measured result may lead to an error in diagnosis, therefore posing a danger to the patient.

Application

The instrument is designed for clinical immunological test analysis using water-soluble samples and reagents.

Please note that other analyses may not be applicable to this instrument.

Operator Qualification

1. Operation should be conducted under the management of a technician who has undergone training at the facility specified by the sales agent.
2. For clinical tests, the instrument should be used under the management of a doctor or clinical inspector.

Operation and Maintenance

1. During operation and maintenance of the instrument, proceed according to the instructions and do not touch any parts of the instrument other than those specified.
2. Do not open the cover while the analyzer is running or operation will be stopped.

Installation Requirements

Installation is performed by a Roche Diagnostics representative. The customer is responsible for providing the necessary facilities as detailed in Section 2.13, Technical Data.

Restriction on Samples and Reagent Solutions

1. The assay cups, detection unit and liquid waste container are not guaranteed to be chemically resistant against organic solvents. Therefore, do not use organic solvents on these parts.
2. Avoid using samples and reagent solutions that are likely to adhere to the assay tips, assay cups, liquid waste container or detection unit.

Handling Reagent Solutions

Follow the manufacturer's instructions for use of reagent solutions.

Loading Samples and Reagents

Be sure to load samples and reagents only into the specified positions on the instrument.

If sample or reagent is spilled, malfunction of the instrument may occur.

Sample/Reagent Disk

Never load new samples onto the sample/reagent disk during the scan process. When loading the sample/reagent disk, follow the instructions in the manual.

Microparticle Mixer

Be careful not to bend the microparticle mixer. A bent mixer could lead to inaccurate results.

Switching On the Instrument

After the analyzer has been switched off, wait approximately 10 seconds before switching it back on.

Instrument Unused for a Long Time

If the instrument will not be used for a long period of time, contact Technical Support. Different shutdown procedures are recommended depending upon the duration of inactivity. In addition, certain procedures require the assistance of a Roche Diagnostics service representative.

1.4.2 Accident Prevention

Elecsys 1010 is a fully automatic analyzer designed according to the most up-to-date safety requirements. This ensures the highest possible protection for the operator from accidents and ensures correct functioning of the system.

Before using the Elecsys 1010, review the safety precautions described in this chapter to avoid operational interruptions and to protect you from potential hazards.

The following overview describes specific features for optimal analyzer and operator protection.

Operator Training

Roche Diagnostics provides system training after which an operator not only works with the Elecsys 1010 but is also familiar with the relevant safety aspects.

Stand-by Operation and Analyzer Preparation

(Stand-by = the analyzer has power, however, the motion functions of the individual components are disabled). In Stand-by mode, the tips of the S/R and sipper probe and the paddle of the microparticle mixer are stowed in their home positions in the rinse stations. Therefore, the operator cannot be injured by the probes.

The sample/reagent disk can be removed from the analyzer. Therefore, loading of samples, reagent packs, calibrators and controls can either be performed on the analyzer or away from the analyzer.

The consumable containers (CleanCell, ProCell, water and waste containers) are replaced or refilled in Stand-by mode.

When all the necessary substances have been loaded on the analyzer, the scan process can be started after closing the cover.

Analyzer Cover

The analyzer cover must be closed prior to starting a run. A run cannot be started when the cover is open. If the cover is opened during initialization, the analyzer stops immediately.

If the cover is opened during a run, the analyzer moves the probes and microparticle mixer to their home positions in the rinse stations within 2 seconds to prevent accidental contact. As a result, the run is stopped.

CAUTION

Opening the analyzer cover during a run may cause results to be lost.

STOP Key

Press the STOP key to stop all operations that Elecsys 1010 is performing as soon as possible. This process is the same as that described for the analyzer cover.

STAT Samples

STAT (Short Turn Around Time) samples can be placed on the analyzer in the designated positions behind the control unit, even when the cover is closed and a run is being performed. Contact with the probes or microparticle mixer is not possible. To load STAT samples, the drawer is pulled forward to expose the STAT positions. There is a mechanical lock present when access is not permitted.

1.5 Approvals

The Elecsys 1010 analyzer was manufactured and tested according to international standard IEC 1010-1, “Safety requirements for electrical equipment for measurement, control and laboratory use, Part 1: General requirements”. This international standard is equivalent to the national standard Underwriters Laboratories (UL) 3101-1.

The analyzer was tested and approved by the VDE and UL and received the following safety marks:

Issued by VDE Testing and Certification Institute, Association of German Electrical Engineers (VDE).

Issued by Underwriters Laboratories, Inc. (UL).

Issued by Underwriters Laboratories, Inc. for Canada as a Certification and Testing Organization by the Standards Council of Canada (SCC).

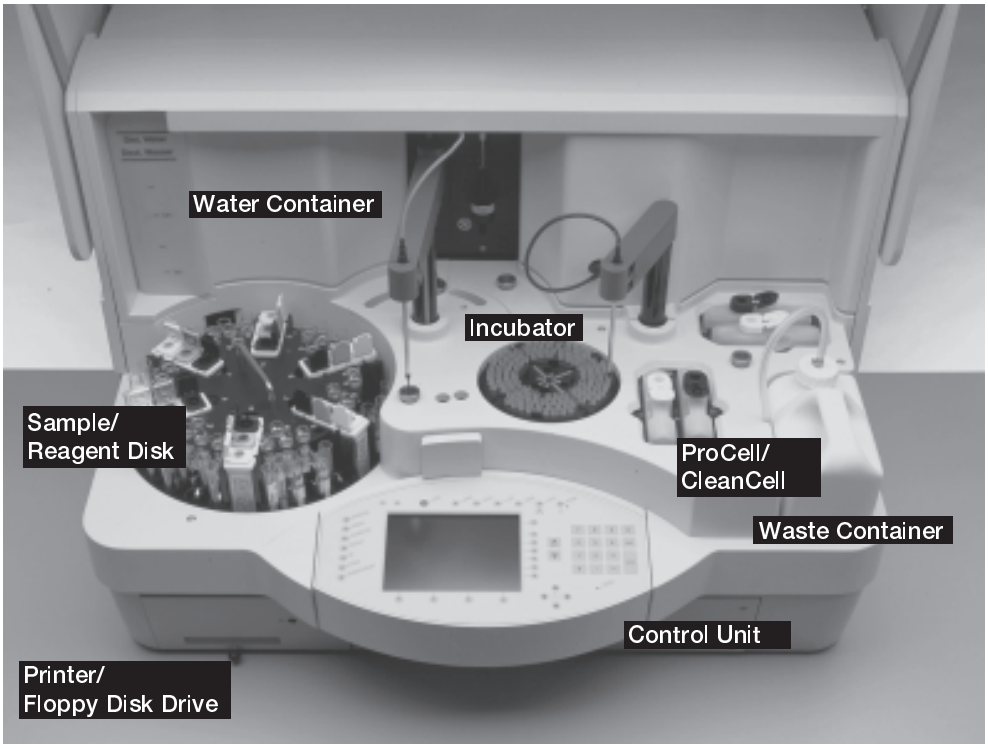
The analyzer complies with the European Union (EU) directive 89/336/EEC (Electromagnetic Compatibility).

2. System Description

2.1 Introduction

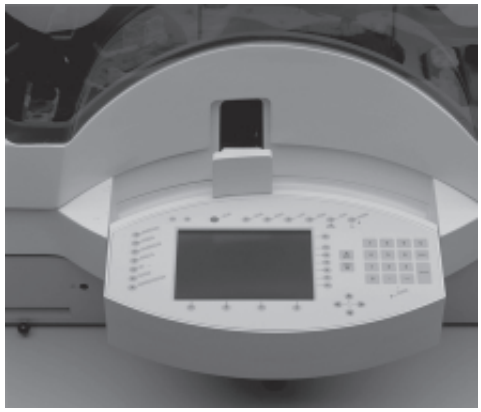
Elecsys 1010 is a fully automated routine and STAT analysis system for the determination of immunological tests using the ECL/Origen electrochemiluminescent process. The system measures samples in the form of serum and plasma. Depending on the test used, the results are produced either as quantitative or qualitative results.

Elecsys 1010 was designed to be placed on a table. The photograph below shows where the components for the daily routine are located on the analyzer. The analyzer has an interface for the connection of a laboratory EDP (host) system. An external printer and a PC-compatible keyboard can also be connected.



The system was designed to be powered on and operated 24 hours a day. Power the analyzer on with the cover down. After configuration run is complete, the analyzer goes into Stand-by and is ready for operation.

2.2 Control Unit

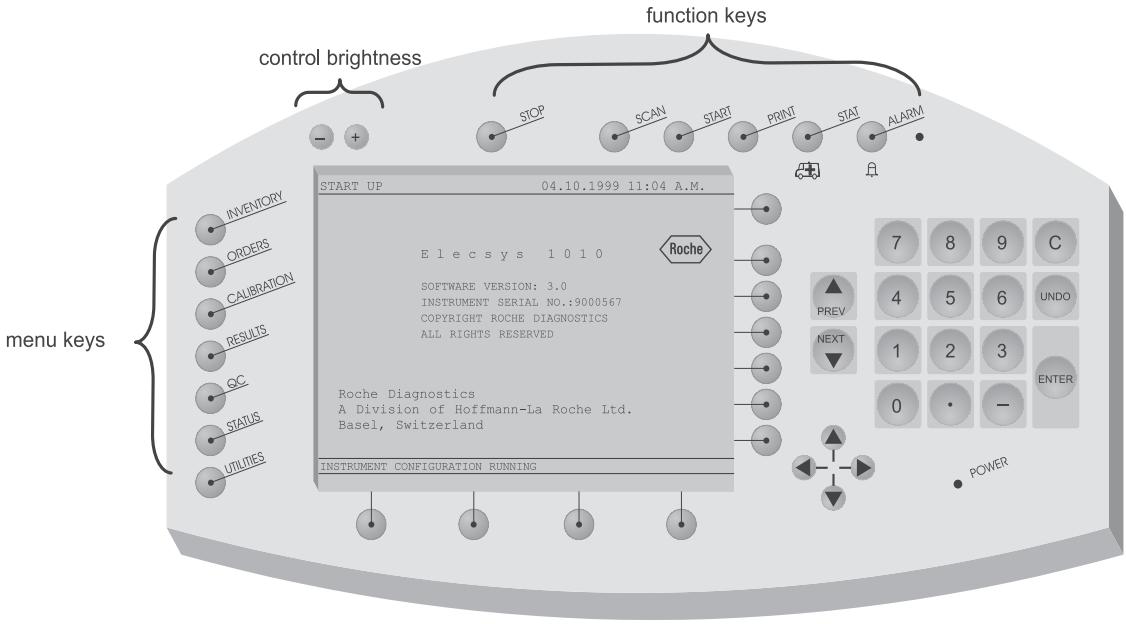


The control unit is easily accessible from the front of the analyzer. It is used by the operator to enter the tasks that the analyzer is to perform.

The control unit is comprised of a keyboard, covered by a plastic protection cover and an LC display (LC = Liquid Crystal).

Located around the LC display (to the right and below the display) are unlabeled keys, called soft keys, which point to the display. The functions of these keys change according to the screen displayed.

All keys with a fixed function [to the left (menu keys) and above the display (function keys)] are labeled accordingly. For example, pressing the SCAN key initiates a scan of bar code-labeled tubes and reagent packs loaded on the sample/reagent disk.



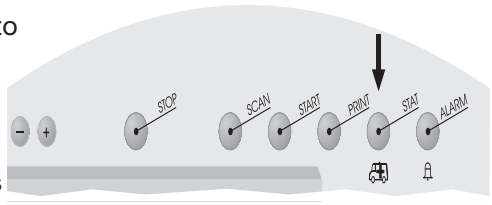
As an option, a PC-compatible keyboard can be connected for entering text and special characters. For this purpose, there is a 5-pin standard connector underneath and to the right of the control unit.

STAT Sample Positions

The control unit is designed like a drawer, which when pulled out provides access to the two STAT positions. During a run, up to two STAT samples at a time can be loaded in primary tubes or when using a special adapter (supplied) in secondary cups.

Normally, access to both STAT positions is always possible. When the STAT key is pressed, the requests for one or both STAT samples can be entered.

When the STAT requests have been confirmed, the control unit is locked into position by the analyzer until all of the requested tests have been pipetted.



The control unit is then immediately unlocked so that further STAT samples can be processed during a run.

Note

A power failure during the pipetting of the STAT samples may lock the control unit. The locking device can be temporarily overridden by inserting a screwdriver below the control unit.

2.3 Sample/Reagent Disk

Patient samples, reagents, diluents, calibrators and controls required for a run are loaded on the sample/reagent disk.

During a run, the disk positions the sample containers so that they can be reached by the S/R probe and the microparticle mixer.

Reagent Positions

The disk has six positions laid out in the form of a star. These positions are used to load six reagent packs for use in a run. The reagent pack positions are labeled from A to F.

Sample, Calibrator and Control Positions

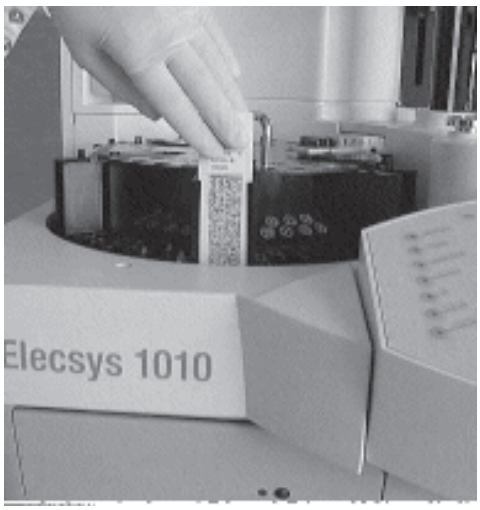
The sample/reagent disk has 66 numbered positions for patient samples, calibrators and controls. The positions 1 to 42 are scanned by the bar code reader and can be loaded, for example, with bar code-labeled primary tubes. The positions 43 to 66 are intended for secondary cups (e.g., Hitachi standard cups).

The bar code positions can be converted into 36 secondary cup positions by using six adapters. This is useful in laboratories that do not want to use primary tubes on Elecsys 1010.

Bar Code Card Holder

At each reagent pack position, there is a slot for inserting a bar code card for calibrators and controls.

The control or calibrator 2D bar code cards contained in the packaging is inserted in an available bar code card slot and is scanned by the bar code scanner (SCAN key).



2.4 Sample/Reagent Arm

The sample/reagent (S/R) arm is located between the sample/reagent disk and the incubator. On one side there is the sample/reagent (S/R) probe and on the other side, the microparticle mixer. During a run the S/R arm moves the mixer or S/R probe to the appropriate pipetting, mixing or rinsing position.

Sample/ Reagent Probe

The S/R probe transfers sample, reagent and microparticles into the assay cups in the incubator.

The S/R probe has an automatic liquid detection system (LLD = Liquid Level Detection) that can detect whether or not there is liquid present. The probe detects the liquid surface when it is lowered into the container. This prevents air from being pipetted when there is insufficient liquid available.

An abnormal descent sensor stops further probe movement when the bottom of the container is detected. This sensor also prevents the probe from being damaged when a reagent pack has not been opened.

Possible clot formation is recognized by a pressure sensor in the S/R pipetting system (clot detection).

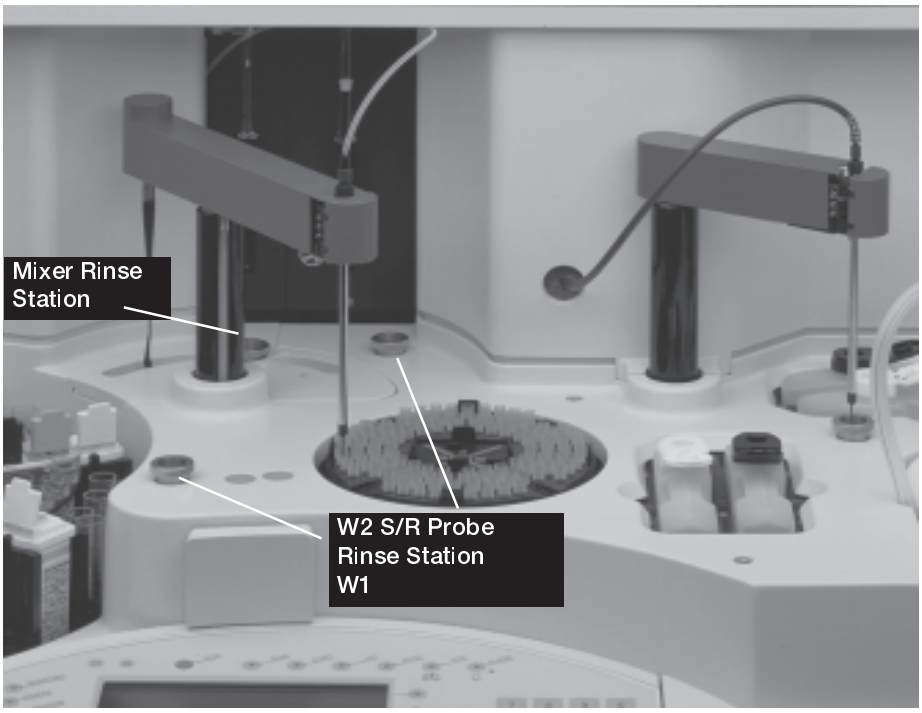
Mixer

At regular intervals, the mixer resuspends the microparticles contained in every reagent pack that are required for analysis.

Rinse Stations

The rinse stations W1 and W2 are used to clean or rinse the S/R probe. A cleaning or rinsing process is performed between the individual aspirations of the liquids (sample, reagent and microparticles).

The mixer has a separate rinse station. The mixer is cleaned before and after resuspension of the microparticles.



2.5 Incubator

The immunochemical reaction is performed in assay cups located in the incubator. The temperature of the incubator is maintained at a constant 37 °C (±0.3 °C).

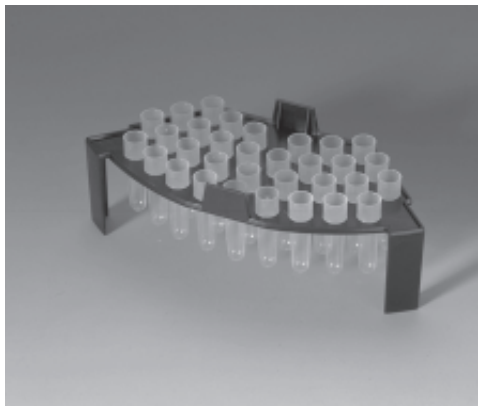
Assay Cups

The reaction of sample, reagent and microparticles takes place in the assay cups. The incubator can hold four pre-loaded segments containing assay cups. These segments are loaded into the positions labeled A through D. Each segment can hold 32 assay cups, thus the maximum number of assay cups is 128 (four segments each with 32 positions).

Assay Cup Segments

The pre-loaded segments can be easily placed into and removed from the analyzer.

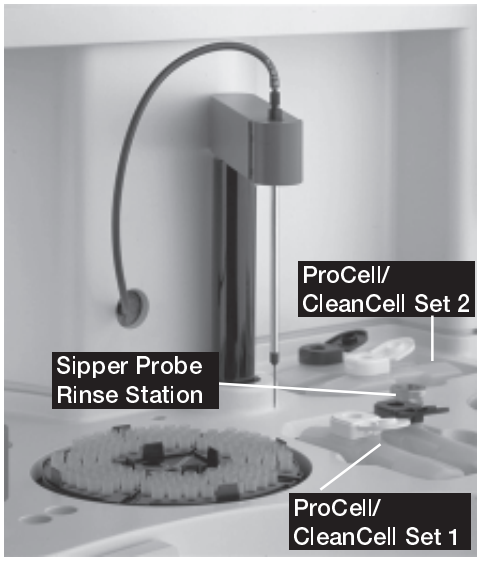
The operator must remove used segments and reload with new segments before or after each run.



The photosensor does not detect the presence or absence of individual cups. Removal and replacement of individual cups will lead to erroneous results. ReSegments in which all the assay cups have been used must be replaced. Partially used segments can remain in the incubator until all 32 assay cups have been used. The INVENTORY screen can be used to display the status of each assay cup.

2.6 Sipper Arm

The sipper probe, located on the sipper arm, transports the reaction mixture from the assay cups to the measuring cell. It also transports CleanCell and ProCell to the measuring cell. The sipper arm can reach all assay cups loaded in the incubator as well as both sets of CleanCell and ProCell.



Sipper Probe

The sipper probe has an automatic liquid detection system (LLD = Liquid Level Detection) that can detect whether or not there is liquid in an assay cup. The probe detects the liquid surface when it is lowered into a ProCell or CleanCell bottle. This prevents air from being pipetted when there is insufficient liquid available.

An abnormal descent sensor prevents the probe from hitting the bottom of an assay cup to avoid damage to the probe and to ensure correct aspiration of the reaction mixture. This sensor also prevents the probe from being damaged when a ProCell/CleanCell bottle has not been opened by the operator.

Rinse Station

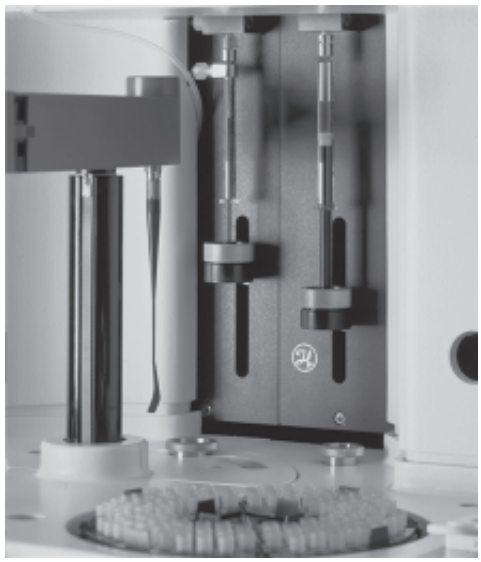
The sipper probe is cleaned in its own rinse station after each pipetting process.

2.7 Liquid System

The liquid system transports sample, reagent, microparticles, CleanCell, ProCell, diluent and distilled water, as well as liquid waste. The components that can be seen by the operator are the pipettors, the tube connections and the containers for distilled water and waste.

Pipettors

Two pipettors, as well as several pumps (behind the housing cover) transport the liquids. The left pipettor is responsible for aspirating and dispensing liquids for the S/R probe and the right pipettor controls liquid transportation through the sipper and detection unit.

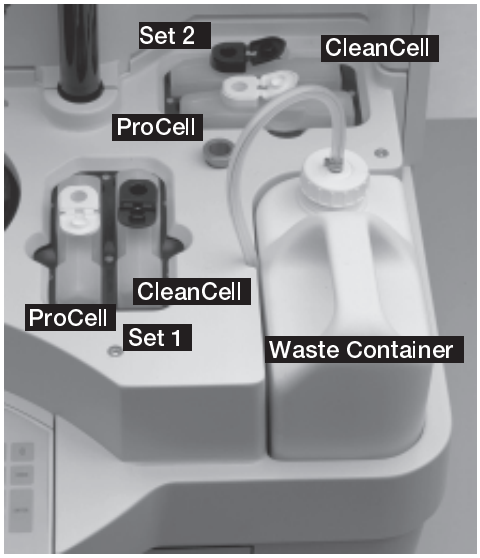


Distilled Water Container

The distilled water container is located on the left of the analyzer. It can hold up to 4 liters of distilled water. The container can be easily removed before and after every run in order to refill it.

Note
Use caution when removing or replacing the distilled water container to ensure no water drips onto the S/R disk.

ProCell and CleanCell



The analyzer has two bottles containing the system reagent ProCell (white caps) and two bottles containing the system reagent CleanCell (black caps). ProCell is the buffer solution required by the measuring cell for the ECL reaction. CleanCell is used to clean the measuring cell.

The compartments where the bottles are located are maintained at a temperature of 28 °C to prevent temperature fluctuations in the measuring cell (also maintained at 28 °C).

One bottle of ProCell and one bottle of CleanCell forms a set. As soon as a set is empty, the other set is used. An empty set should be replaced by two new bottles before or after a run.

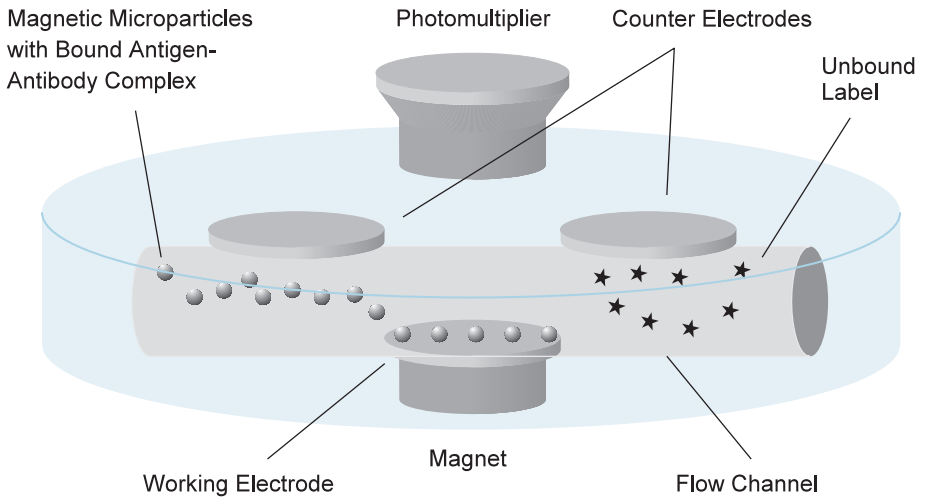
Waste Container

The entire waste liquid is pumped into the waste container located on the right side of the analyzer. The waste container can hold approximately 5.5 liters of waste and can be easily removed and replaced before and after each run to empty it.

2.8 Measuring Cell

The measuring cell is the core of the system. It is located in a light-proof capsule in a housing behind the sipper arm and the temperature is precisely controlled at 28 °C (±0.3 °C). The measurement signals produced are used by the Elecsys 1010 to calculate the results.

The measuring cell is a sealed chamber and consists of a working electrode, counter electrodes, a magnet and a photomultiplier.



When the reaction mixture, consisting of sample and reagent, is placed in the measuring cell, three processes are performed to produce the measurement signals:

Bound/Free Separation

Using a magnet, the streptavidin microparticles coated with antigen-antibody complexes are uniformly deposited on a defined spot of the working electrode. They remain there for the entire measurement period. For a few seconds, a buffer solution (ProCell) is flushed through the measuring cell to wash the microparticles on the working electrode and to flush out excess reagent and sample material.

ECL Reaction

A voltage is applied to the working electrode to initiate the ECL reaction. The light emission, produced by the complex radical reaction, is measured by a photomultiplier. These signals are used by the system to calculate the results.

Releasing the Microparticles and Cleaning the Cell

Once the measurement is complete, the measuring cell is reconditioned with a special cleaning solution (CleanCell) and is ready for a new measurement.

A detailed description of the ECL reaction can be found in Chapter 4, ECL Technology.

2.9 Power Switch

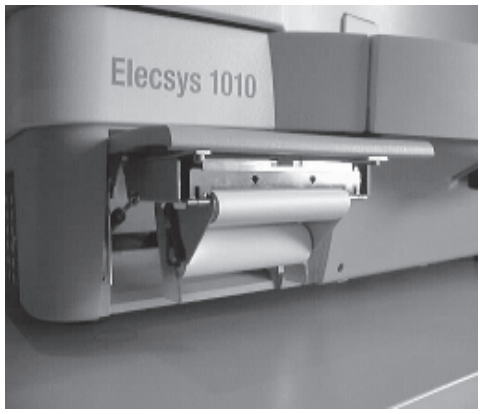
The ON/OFF switch is located on the left of the analyzer. This switch applies voltage to the main power supply (110 to 240 VAC).

2.10 Printer

A thermal printer is located at the front left of the analyzer behind a door.

All results and the most of the displayed screen information can be printed out. To replace the paper, the door can be opened.

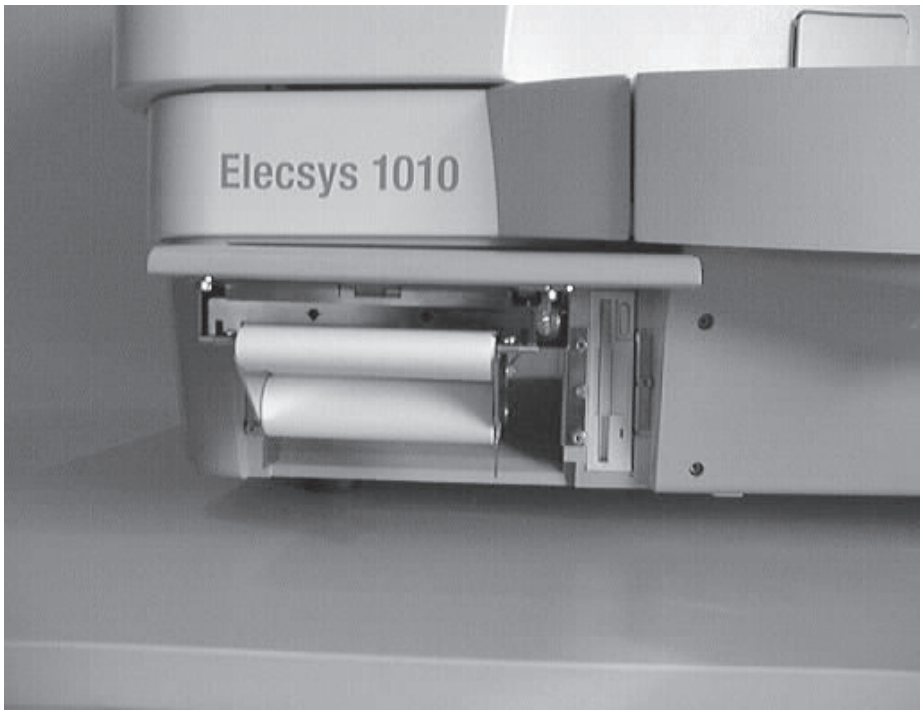
Additionally, a standard parallel interface enables the connection of an external printer (Epson or HP compatible).



2.11 Floppy Disk Drive

The floppy disk drive is located at the front left of the analyzer next to the thermal printer.

The disk drive can be used to archive data (i.e., store results) and read reference data into the system. To insert or remove a disk, simply open the door to access the disk drive.

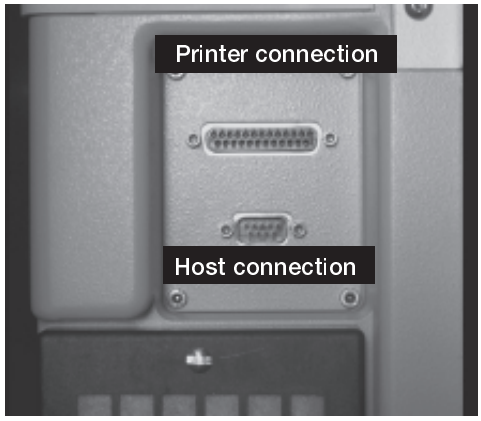


2.12 Interfaces

Elecsys 1010 can be connected to a laboratory EDP (host) system to transfer information. An external printer and an external keyboard can also be connected. There are three connections for these purposes.

Printer Connection (Parallel Interface)

To the left of the analyzer, there is a parallel interface connection for an optional external printer (Epson or HP compatible). This printer can be used instead of the internal printer for printing results. The printer type is set in UTILITIES (INTERFACE SETUP screen). Refer to the relevant printer documentation to see how the connected printer operates.

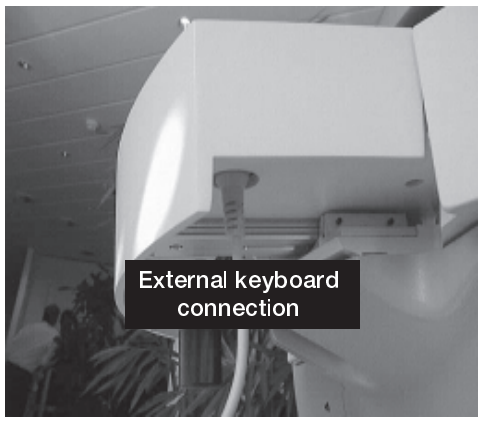


Host Connection (Serial Interface)

To the left of the analyzer, below the printer connection, there is a bidirectional serial interface connection for a laboratory EDP (host) system. The host specifications must be set in UTILITIES (INTERFACE SETUP screen and INSTRUMENT SETUP screen).

External Keyboard Connection

To the right of the control unit, there is a connection for an optional standard PC keyboard. The keyboard can be used to enter text and special characters which are not possible with the control unit keyboard. Once the external keyboard is connected, no further settings are required. Both keyboards can be used together. The keys on the external keyboard that can be used for specific functions are specified in Chapter 1, Introduction.



2.13 Technical Data

Analyzer Dimensions

Height	24.68 in (62 cm)
Depth	31.04 in (78 cm)
Width	38.21 in (96 cm)
Weight	Approx. 243 pounds (110 kg) empty

Electrical Connection

Installation requirements	Pollution degree: 2 (IEC 1010-1)
Overvoltage category	II (IEC 664) Elecsys 1010 should only be connected to a grounded power supply.
Voltage	110-240 VAC ± 10%, single phase
Frequency	50/60 Hz
Power consumption	Max. 610 VA
Heat generation	Approx. 1800 kJ/h

Environmental Conditions

Temperature	18 °C to 32 °C (during run), 15 °C to 35 °C (in Stand-by mode), -25 °C to +70 °C (for transportation)
Temperature variation	≤ 3 °C (during run) ≤ 5 °C (in Stand-by mode) 20 K/h (for transportation)
Relative humidity	20% to 85% without condensation (during run and in Stand-by mode) 10% to 90% (for transportation)
Atmospheric pressure (height above sea level)	70 to 106 kPa (2200 m during run and in Stand-by mode), 4300 m (for transportation)

Noise level (DIN 43635)	
Continuous noise	Max. 60 dBA
Peak noise	Max. 65 dBA
Water Supply	
Water container	Approx. 4 L
Water quality	< 10 µS/cm or > 0.1 megohm, bacteria-free
Water consumption	Approx. 2.8 L for 100 tests
Liquid waste	
Liquid waste container	Approx. 5.5 L (can be cleaned in a dishwasher)
Throughput	
Determinations	Typically 50/h, max. 60/h (tests with pretreatment and dilution reduce the throughput by approx. 50%)
Samples	
Sample/ Reagent pipettor precision	< 1.5% CV at 10 µL <1% CV at 50 µL
Sample volume per test	10 µL to 50 µL
Sample detection	Liquid level detection of S/R probe
Positions on sample/ reagent disk for samples, adapters,	42 positions for primary tubes or 36 positions with secondary cups
calibrators and controls	24 positions for secondary cups, 2 additional positions for STAT samples
Sample bar codes	NW7 (Codabar), Code 39, Code 128, Interleaved 2 of 5

Sample Cups

Primary Tubes

Type	Volume (mL)	External Diameter (mm)	Height (mm)	Dead Volume (µL)
SARSTEDT MONOVETTE	10.0	16.5	92	500
SARSTEDT MONOVETTE	4	15.3	57	500
SARSTEDT SERUM-GEL MONOVETTE	9.0	16.5	92	500
BECTON DICKENSON SST 3206	5.0	13.0	75	300
BECTON DICKENSON VACUTAINER + GEL SST 3202	10.0	16.0	75	400
BECTON DICKENSON VACUTAINER + GEL SST 3200	10.0	16.0	100	400
TERUMO VENOJECT II	5.0	13.25	100	300
TERUMO VENOJECT II	10.0	15.65	100	500
SEKISUI Primary cup	10.0	16.2	100	500
SEKISUI Primary cup	7.0	14.0	100	500

Secondary Cups

Type	Dead Volume (µL)	Note
HITACHI Sample Cup in secondary positions (42-66)	60	The sample volume may not be less than or equal to 60 µL.
HITACHI Sample Cup in secondary adapter	60	
HITACHI Micro Cup in secondary positions (42-66)	30	The sample volume may not be less than or equal to 30 µL.
HITACHI Micro Cup in secondary adapter	30	
Secondary or pour-off tube, 16 mm X 100 mm	280	
Secondary or pour-off tube, 13 mm X 75 mm	235	
Others	It is recommended that secondary cups other than those specified here be checked before they are used on the analyzer. The operator must ensure that there is sufficient sample in the cup.	

Cup on Tube (COT)

Type	Dead Volume (µL)
HITACHI Sample Cup Cup on Tube 16x95, COT Parameter	50

Special cups

	Dead Volume (µL)
Control / calibrator vials	80

Reagents

Reagent capacity	6 reagent positions
Reagent detection	Liquid level detection by S/R probe
Bottle volume of ProCell and CleanCell	380 mL
Reagent ID	2D bar code, PDF 417

Incubator

Incubator capacity	128 assay cups
Volume of assay cups	typically 200 µL, max. 400 µL
Incubation temperature	37 °C ± 0.3 °C
Incubation period	9/18 minutes

Measurement System

Measurement method	Integral measurement of an electrochemiluminescent signal
Calibration mode	2-point calibration

PC

Processor	486 X
Floppy disk	3.5 FD/1.44 MB

Interfaces

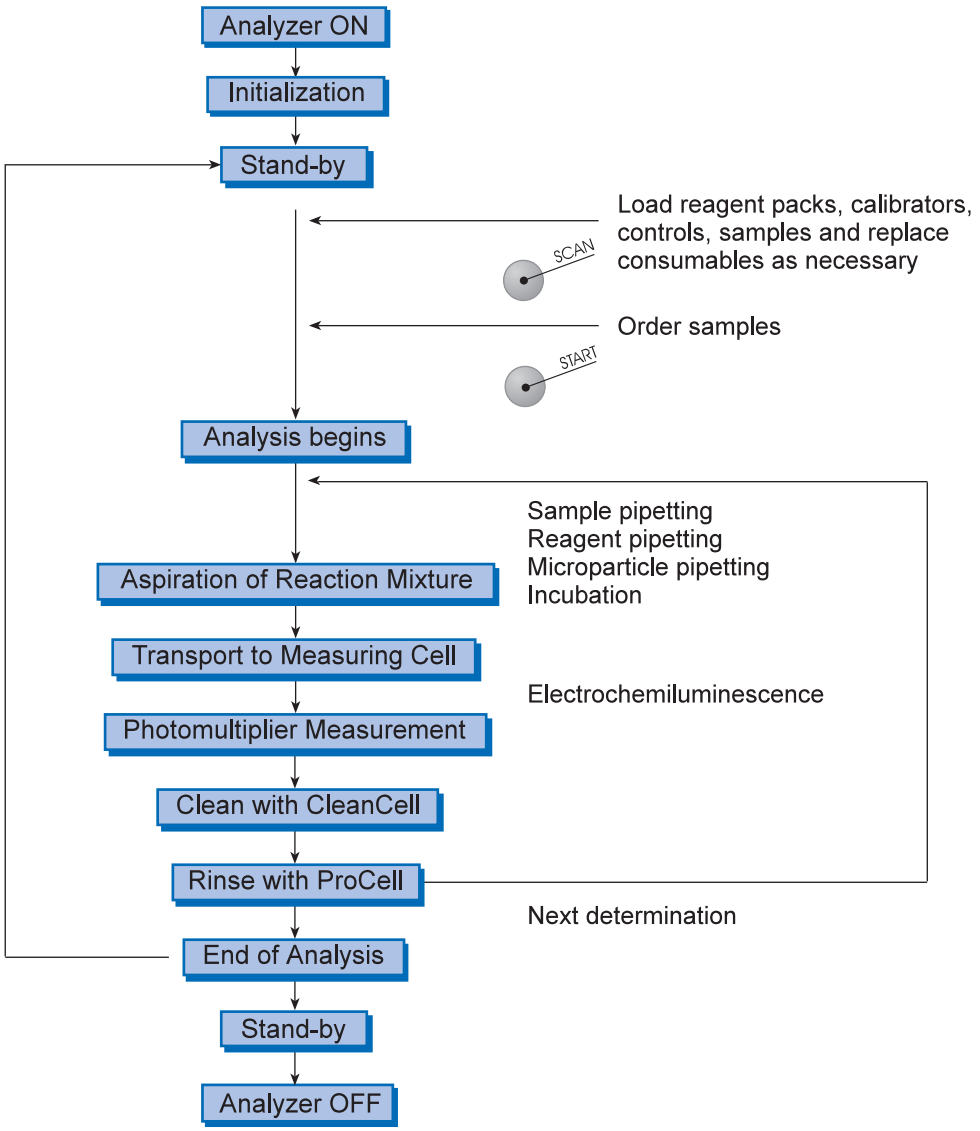
Printer	Centronics
HOST computer	CCITT V.24/RS-232-C (bidirectional) The host computer must comply with the requirements of IEC 950
LCD	S/W VGA - LCD with 640 x 480 pixels
Thermal Printer	Paper width 110 mm

3. Functional Sequence of Analysis

3.1 Introduction

The basic functional sequence of the system is detailed in this chapter using a flow chart and a short description. An overview of the sequence of events for each test protocol is graphically displayed. A detailed description using the test TSH as an example provides insight into how the Elecsys 1010 operates.

Flow Chart of the Analysis Sequence



3.2 General Analysis Sequence

An immunological ECL test is made up of various pipetting steps, at least one incubation period and a measurement step. Generally, at least three test components (sample, reagent and microparticles) are pipetted into an assay cup. After the appropriate incubation period, the reaction mixture is aspirated into the measuring cell where the measurement process takes place. Each of these pipetting cycles is performed within a defined period (approximately 60 seconds).

The number of pipetting steps and assay cups used, as well as the make up of the reaction mixture, are dependent on the test method (refer to Chapter 3.3, Test Sequences).

After each pipetting step, the sample/reagent probe is cleaned and, if necessary, the microparticle mixer and sipper probe are also cleaned.

The following steps apply in principal to all methods. The sequence of the individual processes differs from test to test.

Resuspension of the Microparticles

During this step the microparticles are resuspended by the mixer on the sample/reagent arm at the beginning of a new run. Resuspension takes place before the microparticle suspension is aspirated. At the same time, the S/R probe is thoroughly cleaned. After resuspension, the mixer is cleaned with water in its special rinse station.

Pipetting of at Least Two Liquids (e.g. Reagent 1 and Sample)

At the beginning of a run, at least one reagent and the sample or microparticles are aspirated one after the other by the S/R probe. After each aspiration of a liquid, the outside of the S/R probe is quickly rinsed at a rinse station. Afterwards, all liquids are dispensed into an unused assay cup. The inside and outside of the probe is then thoroughly cleaned again.

First Incubation at 37 °C

The incubation period is 4.5 or 9 minutes, depending on the test. Tests without pretreatment have two incubation periods, whereas tests with pretreatment require additional incubation periods.

Pipetting of Additional Reagents (e.g. Reagent 2 and Microparticles)

In the second pipetting step, one or two liquids are pipetted (refer to Scan be selected using the arrow keys Chapter 3.3, Test Sequences). The outside of the S/R probe is rinsed at the rinse station after every aspiration of a liquid. The liquid is then dispensed into an assay cup that contains the sample and the other liquids from the first pipetting process.

Second Incubation at 37 °C

If necessary, a second incubation period of 4.5 or 9 minutes occurs, depending on the test.

Additional Reagent Pipetting (Pretreatment assays)

For pretreatment assays, reagent pipetting similar to that described above for “Pipetting of Additional Reagents” occurs.

Third Incubation at 37 °C

If necessary, a third incubation step (9 min) occurs for pretreatment assays.

Reaction Mixture Aspiration and Measurement

In this process, the sipper probe first aspirates ProCell to prepare the measuring cell. Then, the sipper probe aspirates the reaction mixture and transfers it to the measuring cell. After the sipper probe is washed at the rinse station and ProCell is aspirated again, the ECL reaction can take place in the measuring cell.

Measuring Cell Cleaning and Results

Once the measurement is complete, the measuring cell is cleaned with CleanCell and prepared for a new measurement process. At the same time, Elecsys 1010 calculates the results according to the measured signals.

3.3 Test Sequences

Legend

0 to 29	Test protocols

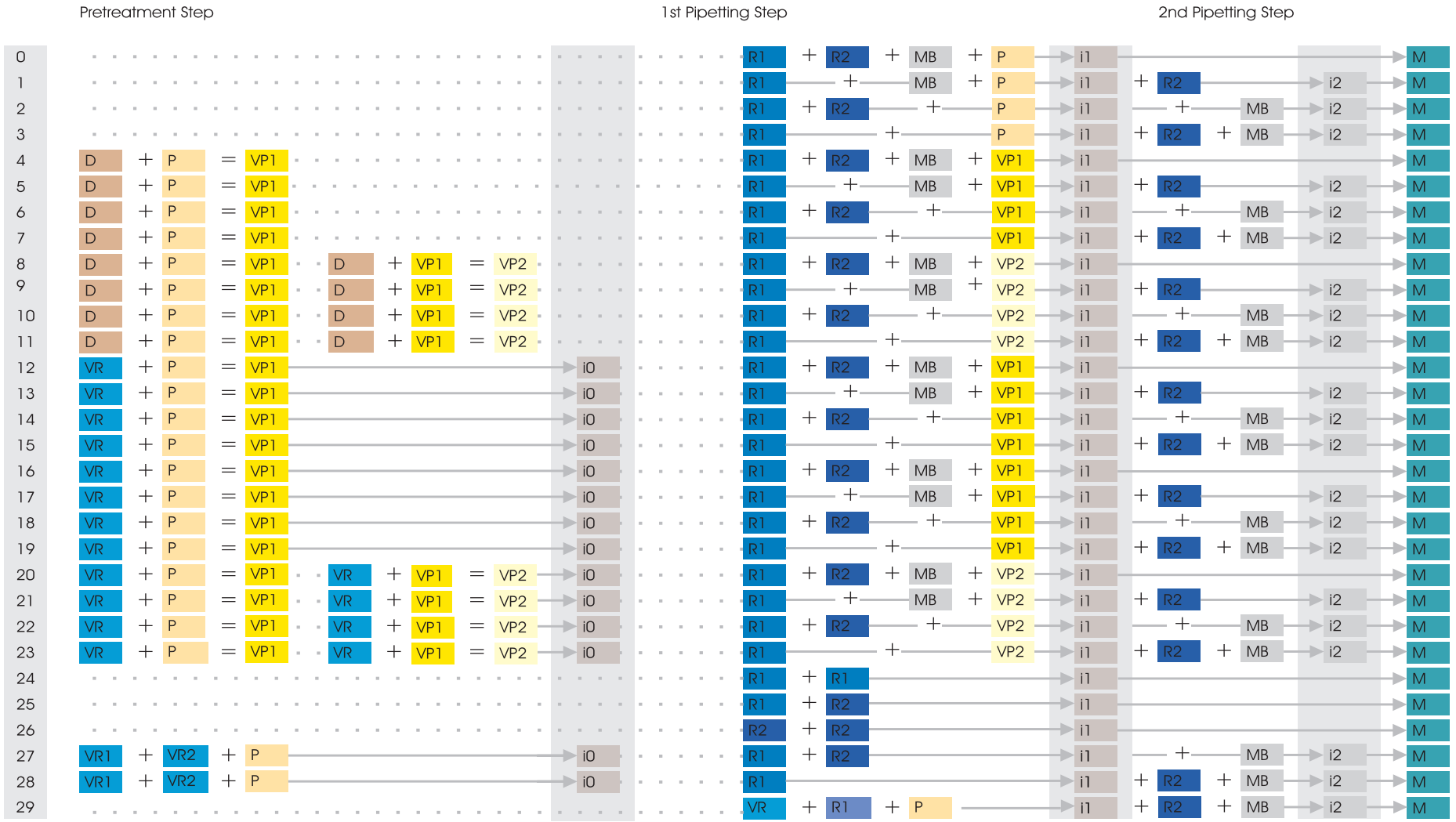
Test analysis steps

D	Diluent pipetting
R1	Reagent 1 pipetting
R2	Reagent 2 pipetting
VR	Pretreatment reagent pipetting
VP1	Diluted sample pipetting once
VP2	Diluted sample pipetting twice
MB	Microparticle pipetting
P	Sample pipetting
i0	Pretreatment
i1	First incubation
i2	Second incubation
M	Measurement

Symbols

+	Addition of
=	Result of the addition
→	Transfer
· · ·	New assay cup

3.3.1 Test protocol



3.4 Example of an Analysis Process

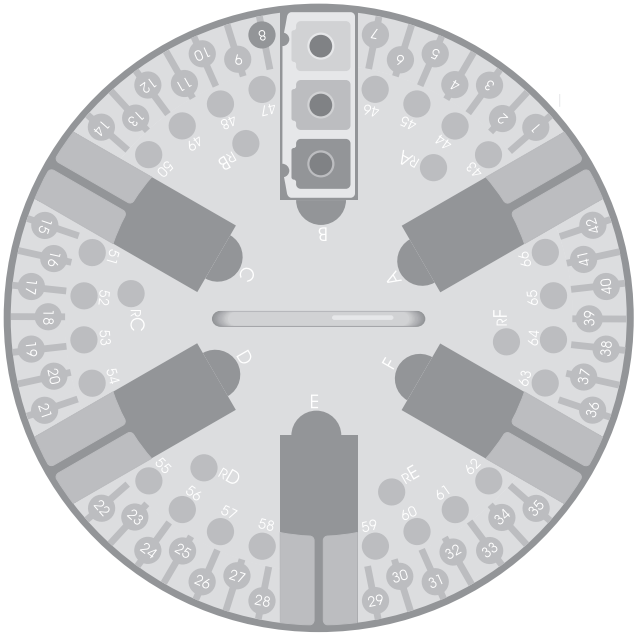
The following describes an analysis process on Elecsys 1010 using the test TSH as an example. Test protocol number 2, used for the TSH test, is described in this example (refer to the table on page 3-7).

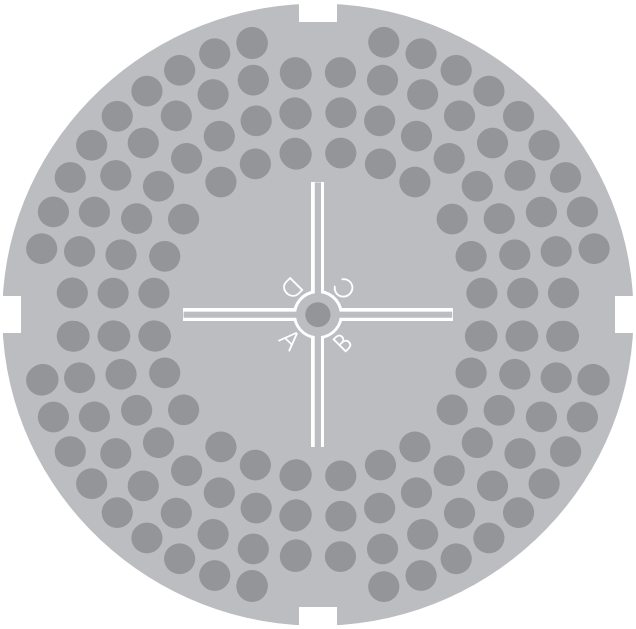
In this example, sample position number 8 (bar code readable) is used and the TSH reagent pack is loaded in position B. All positions on the sample/reagent disk theoretically can be freely chosen for samples as well as reagent packs. The system automatically recognizes the positions loaded with reagents and bar-coded primary tubes due to the presence of a bar code. Samples in non-bar-coded primary tubes or secondary cups (43-66) must be manually assigned a position number.

There are four assay cup segments that can be loaded before the run. Elecsys 1010 uses the next unused assay cup for the first pipetting process. The position of this cup is stored after it is initially used so that, if necessary, the relevant liquid (e.g. Reagent 2) is pipetted into this assay cup during the second pipetting process.

The diagrams below show the sample/reagent disk (S/R disk) and the incubator, respectively.

Sample / Reagent disk





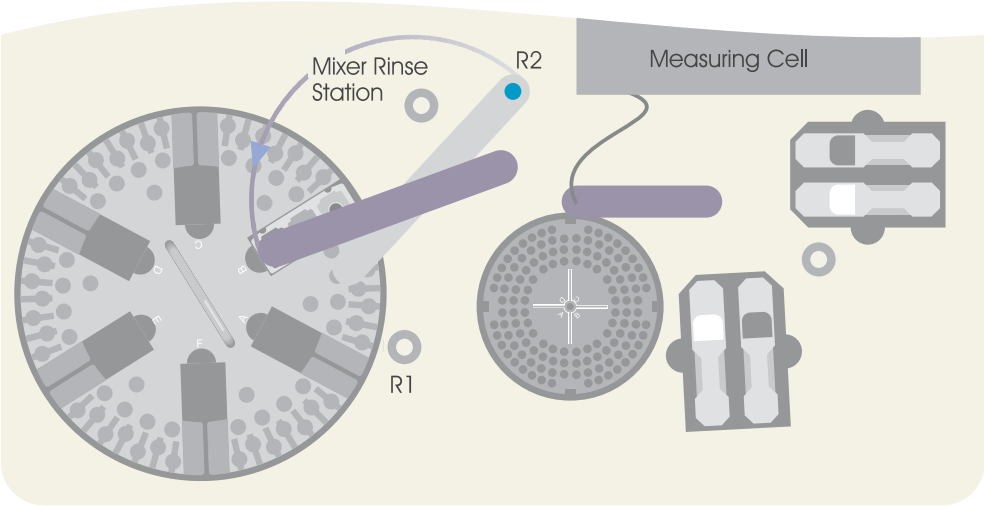
Incubator

The sample/reagent arm, with the S/R probe on one side and the microparticle mixer on the other, can reach each of the 66 positions on the S/R disk and the two STAT positions.

Each of the 128 incubator positions can be reached by the S/R probe as well as the sipper probe.

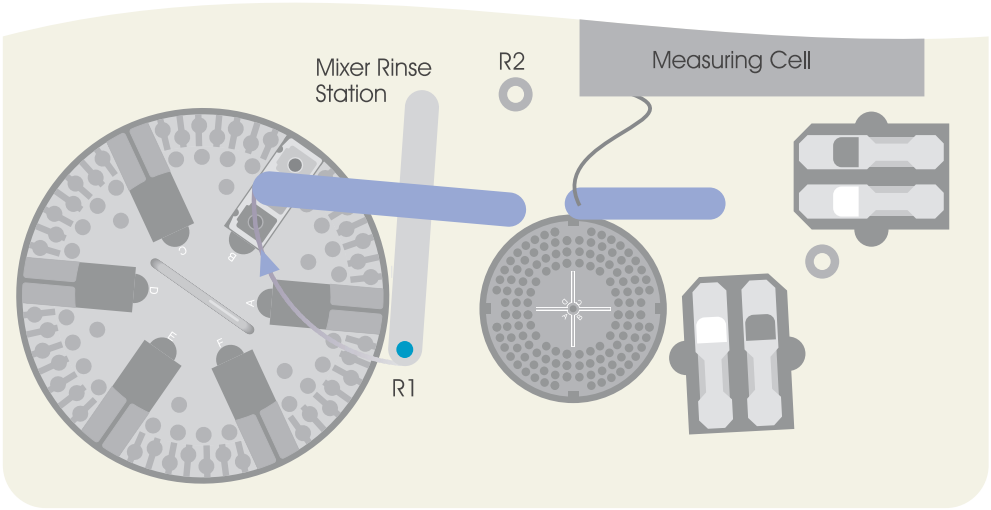
3.4.1 Reagent 1, Reagent 2 and Sample Pipetting

The sample/reagent disk and the sample/reagent arm rotate in such a way that the probe can reach the TSH reagent pack. While the S/R arm is rotating to the S/R disk, 50 µL of air are aspirated into the S/R probe to form an air buffer between the water in the liquid system and the liquids to be aspirated in the following steps.

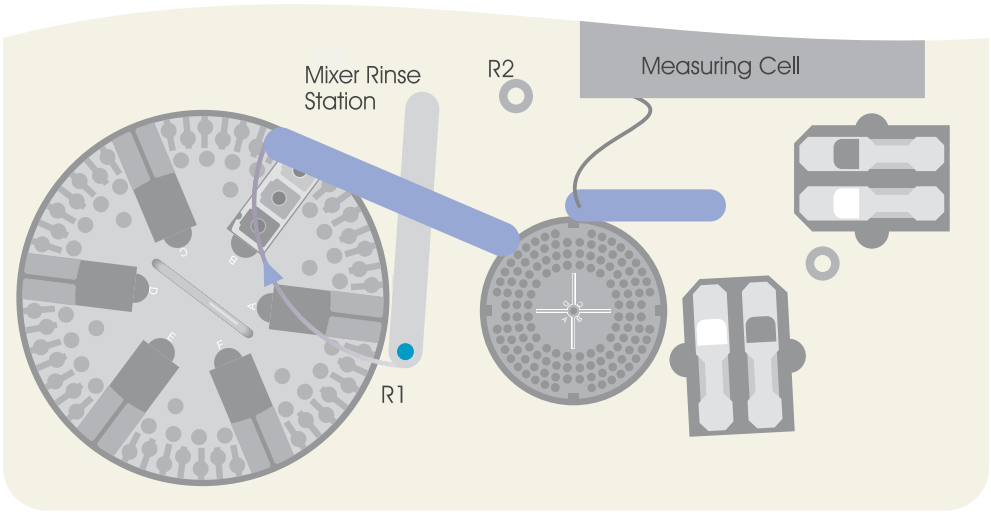


When the S/R arm has reached the TSH reagent pack, the probe is lowered into the TSH reagent pack containing Reagent 1 until the probe has reached the liquid surface, then 60 µL of Reagent 1 are aspirated.

To prevent carryover of Reagent 1, the outside of the probe is quickly cleaned. The arm rotates to rinse station 1, the front rinse station for the S/R probe, and is lowered for cleaning. In the meantime, the S/R disk has rotated so that the S/R probe can reach the bottle containing Reagent 2.



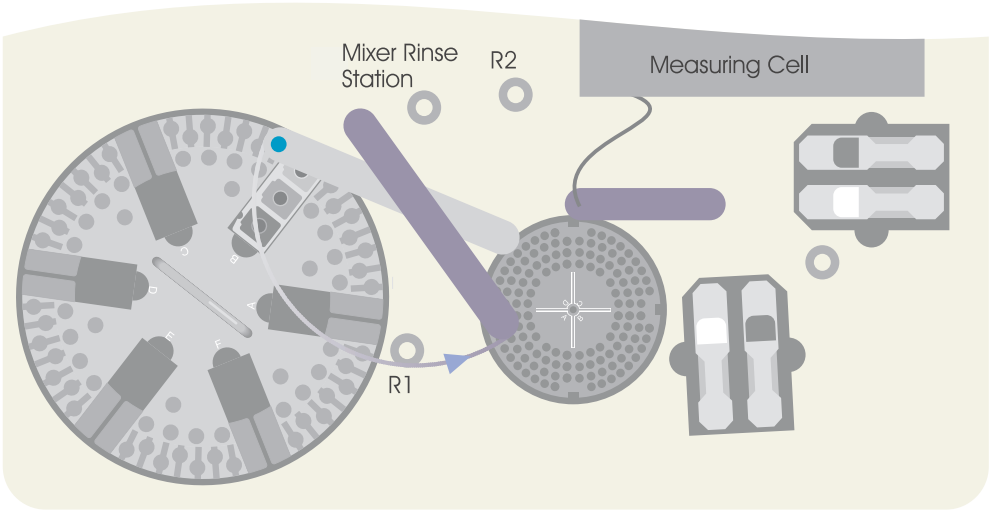
The arm rotates out of the rinse station and back to the S/R disk. The S/R probe aspirates 50 µL of Reagent 2.



The arm then returns to rinse station 1 where the S/R probe is cleaned again. At the same time, the S/R disk rotates so that the probe can reach the necessary sample cup. In this example, this is the sample cup at position number 8. After the S/R arm has rotated back, it is lowered over position 8 until the probe reaches the liquid surface. The probe aspirates 50 µL of sample. During aspiration, the probe tip is kept just below the falling liquid level. Additionally, a check occurs to detect whether clots have formed in the sample container. This clot detection check is performed during every sample aspiration.

3.4.2 First Incubation

The probe now contains Reagent 1, Reagent 2 and sample. Next, the S/R arm rotates to the incubator.

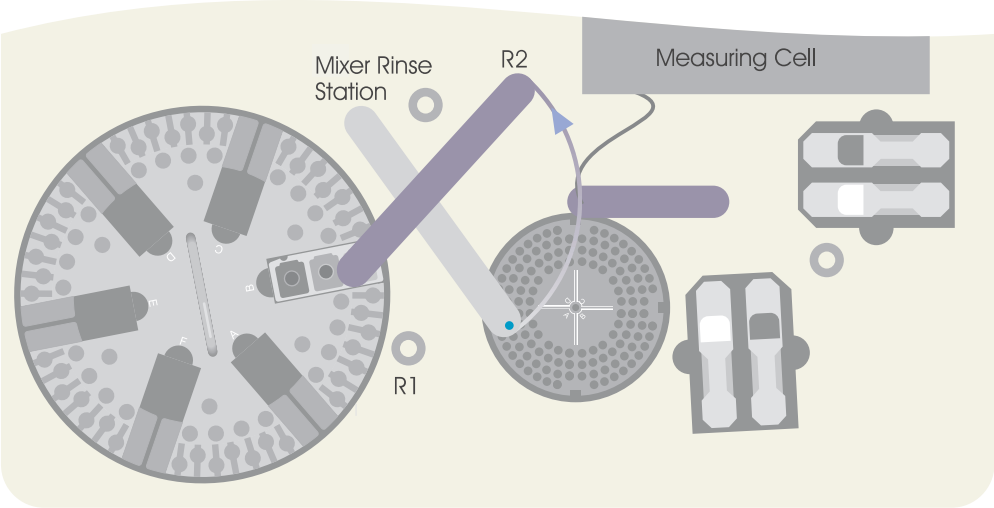


The probe dispenses the liquids in the next, unused assay cup.

The reaction mixture is incubated at 37 °C for 9 minutes. In the meantime, other samples/tests can be processed.

After the liquids have been dispensed into an assay cup, the S/R arm rotates to rinse station 2 and the inside and outside of the S/R probe are thoroughly cleaned.

3.4.3 Resuspension of the Microparticles

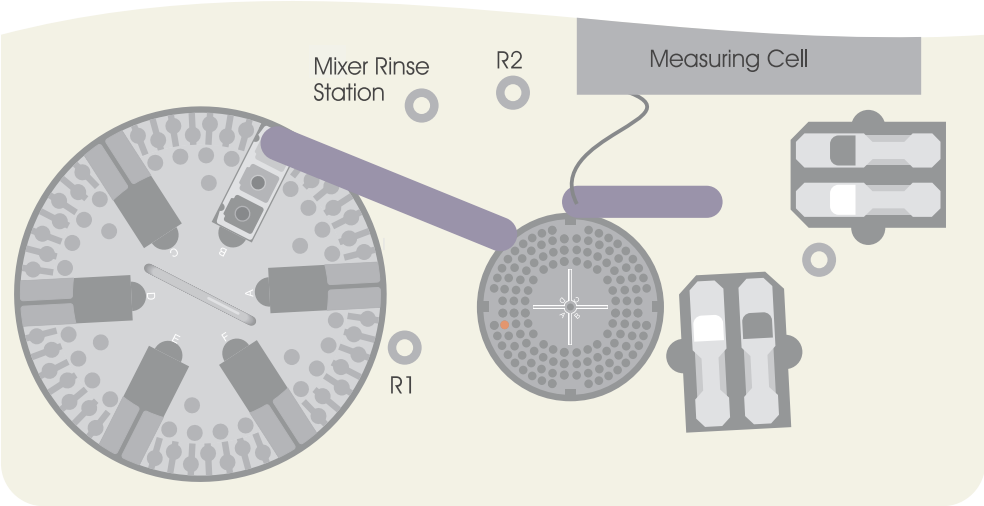


While the S/R arm is rotating to rinse station 2, the microparticle mixer rotates to the S/R disk so that the mixer can be lowered into the TSH reagent pack bottle containing the microparticles. The S/R disk has already rotated to the correct position.

At the same time as the S/R probe is being cleaned at rinse station 2, the microparticle mixer starts to mix (resuspend) the microparticles. This process takes place before each pipetting of the microparticles.

3.4.4 Microparticle Pipetting

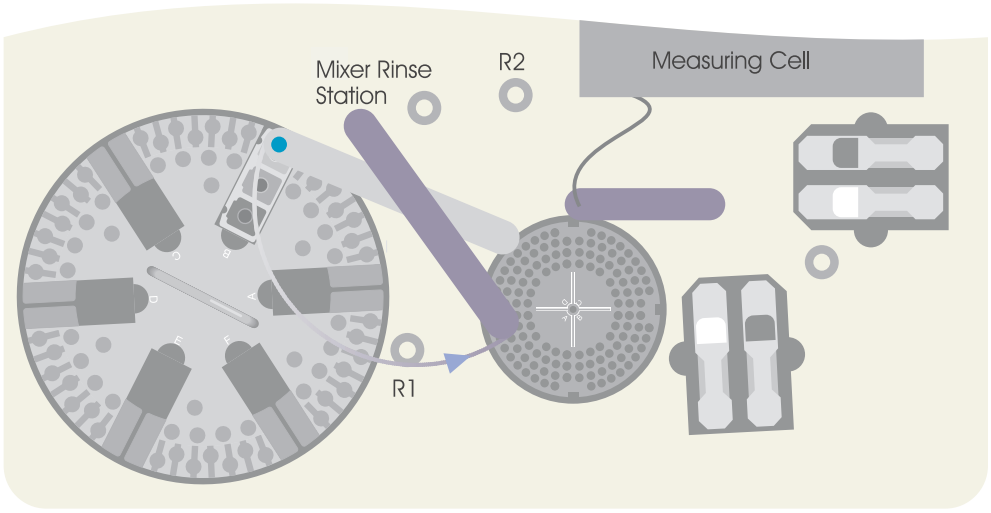
After the resuspension of the microparticles and the thorough cleaning of the S/R probe at rinse station 2, the S/R arm and the S/R disk rotate in such a way that the probe can reach the bottle containing the microparticles.



On reaching the TSH reagent pack, the probe aspirates 40 µL of the microparticle suspension. During the aspiration process, the automatic LLD check occurs. Afterwards, the arm rotates to the incubator.

The probe now contains the microparticles. The incubator rotates so that the S/R arm can reach the assay cup that contains the reaction mixture, Reagent 1, Reagent 2 and sample, from the first pipettor step. The probe dispenses the microparticles into the assay cup.

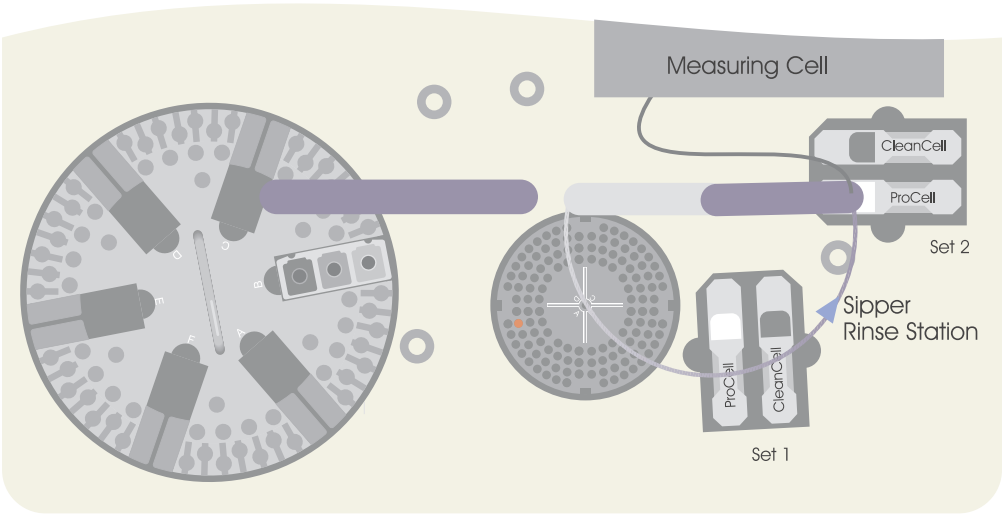
3.4.5 Second Incubation



The liquid mixture is again incubated at 37 °C for 9 minutes (Second incubation). During this period, other samples/tests can be processed.

3.4.6 Measurement Stage

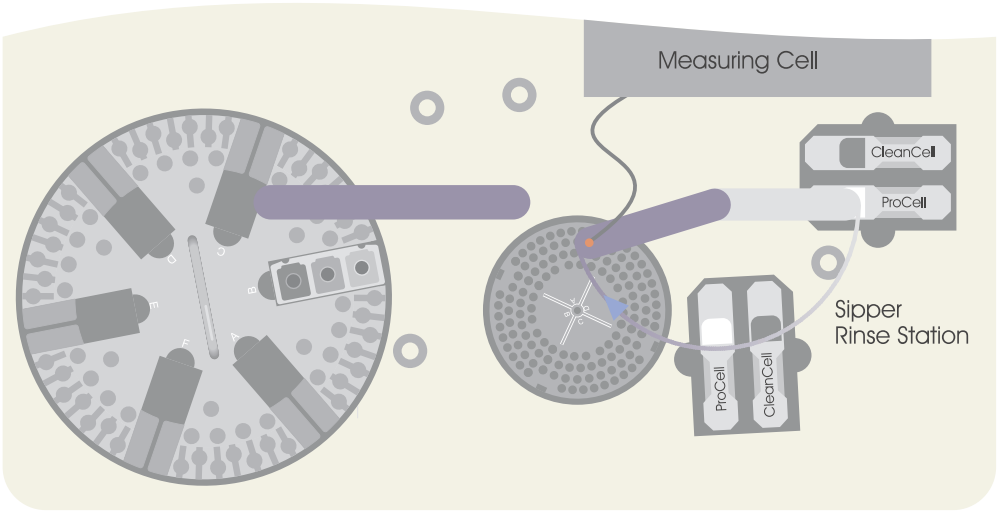
Before the reaction mixture is transferred to the measuring cell, the measuring cell is pretreated with ProCell.



The sipper arm rotates to the bottle containing ProCell and the probe aspirates ProCell. In this example, this is the ProCell and CleanCell Set 2 location. The liquid is drawn through to the measuring cell.

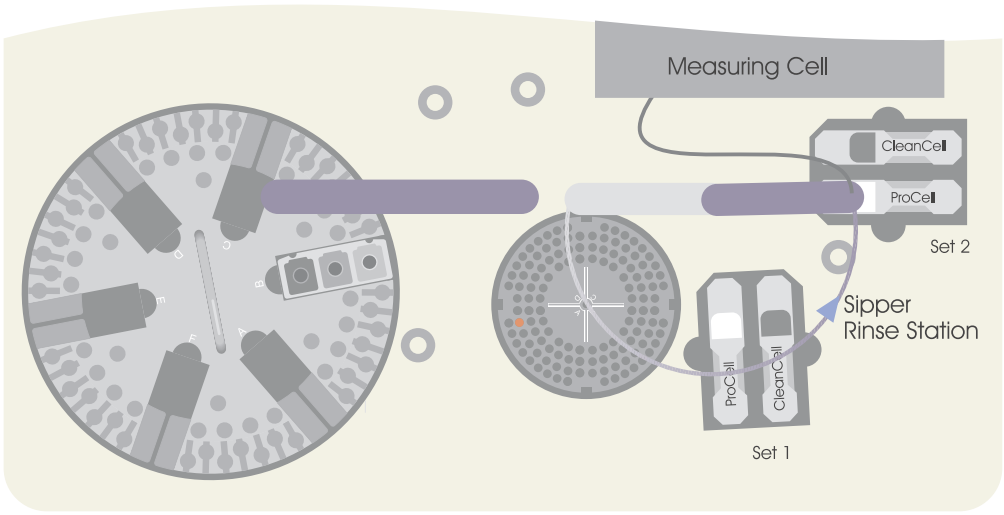
Note

One ProCell and one CleanCell bottle form a set. The volumes of both bottles are matched to one another. If a set is empty, the system automatically uses the second set.



The sipper arm and incubator rotate towards one another so that the sipper probe can reach the cup containing the TSH reaction mixture.

The arm is lowered and the sipper probe aspirates 130 µL of the reaction mixture; the liquid is transferred to the measuring cell. The sipper arm then rotates to the separate rinse station for the sipper probe and is lowered. The probe is quickly cleaned from the outside.



The arm rotates to the bottle containing ProCell and the sipper probe aspirates ProCell. In this example, this is Set 2. The liquid is drawn through to the measuring cell.

3.4.7 Measurement and Evaluation

The measurement in the cell is performed at 28 °C. As soon as the ECL reaction has taken place, the photomultiplier detects the emitted light and converts this into measurement signals. Elecsys 1010 calculates the result from these signals. The ECL process is described in Chapter 4, ECL Technology.

3.4.8 Measurement Cell Cleaning and Preparation for the Next Measurement

The sipper probe again aspirates ProCell to clean the measuring cell and to prepare it for the next measurement. The measuring cell is rinsed out using this liquid. The sipper arm then rotates to the bottle containing CleanCell and aspirates CleanCell. Using this strong alkaline liquid, the measuring cell is thoroughly cleaned and thus ready for the next measurement.

4. ECL Technology

4.1 ECL Technology

The last decade has seen the development and refinement of many new immunoassay measurement principles and systems. The major trend has been away from liquid phase assays with radioisotopic labels and towards fast solid-phase assays based on monoclonal antibodies. This development is moving further towards precise and reliable non-isotopic, automated or semi-automated laboratory assays with detection limits measured in the picomolar (10^{-12}) and attomolar (10^{-18}) range.

ECL Assay Principles

Electrochemiluminescent (ECL) processes are known to occur with numerous molecules including compounds of ruthenium, osmium, rhenium or other elements.

ECL is a process in which highly reactive species are generated from stable precursors at the surface of an electrode. These highly reactive species react with one another producing light.

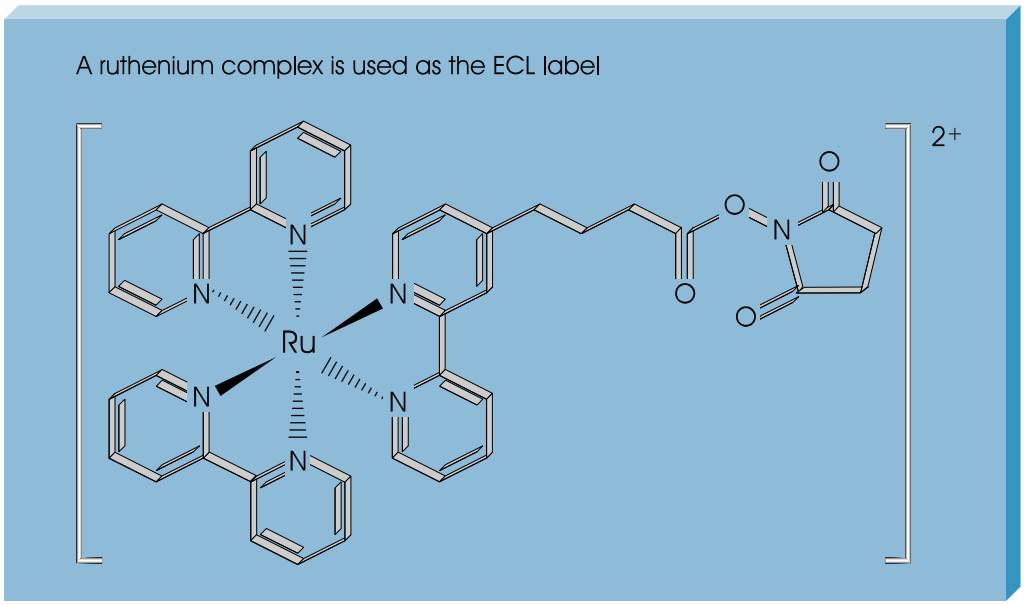
The development of ECL/Origen immunoassays is based on the use of a ruthenium(II)-tris(bipyridyl) [Ru $(bpy)_3^{2+}$] complex and tripropylamine (TPA). The final chemiluminescent product is formed during the detection step.

The chemiluminescent reactions that lead to the emission of light from the ruthenium complex are initiated electrically, rather than chemically. This is achieved by applying a voltage to the immunological complexes (including the ruthenium complex) that are attached to streptavidin-coated microparticles. The advantage of electrically initiating the chemiluminescent reaction is that the entire reaction can be precisely controlled.

Use of the Ruthenium Complex

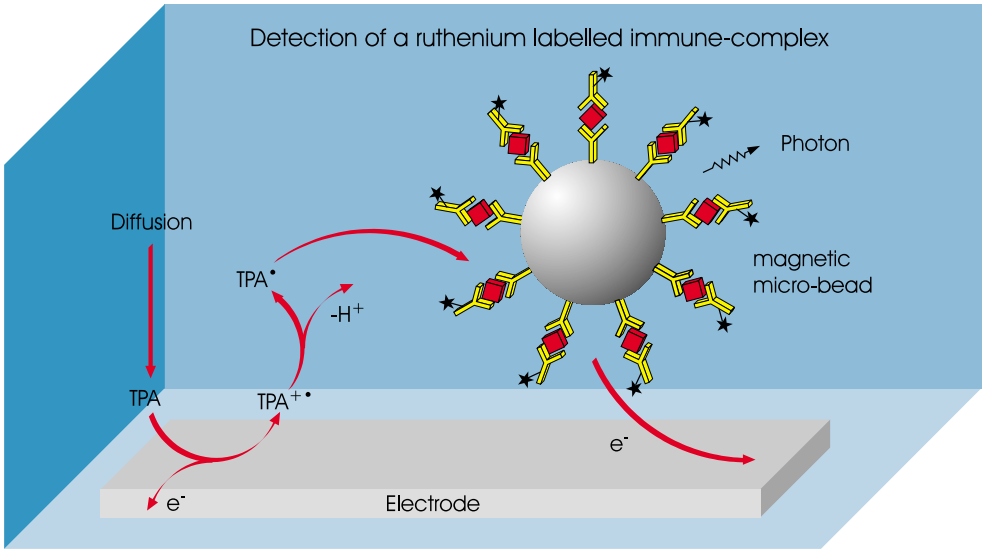
ECL technology uses a ruthenium chelate as the complex for the development of light. Salts of ruthenium-tris(bipyridyl) are stable, water-soluble compounds. The bipyridyl ligands can be readily modified with reactive groups to form activated chemiluminescent compounds.

For the development of ECL immunoassays, $[Ru(bpy)_3^{2+}]$ N-hydroxysuccinimide (NHS) ester is used because it can be easily coupled with amino groups of proteins, haptens and nucleic acids. This allows the detection technology to be applied to a wide variety of analytes.



The ruthenium complex

The ECL Reaction at the Electrode Surface

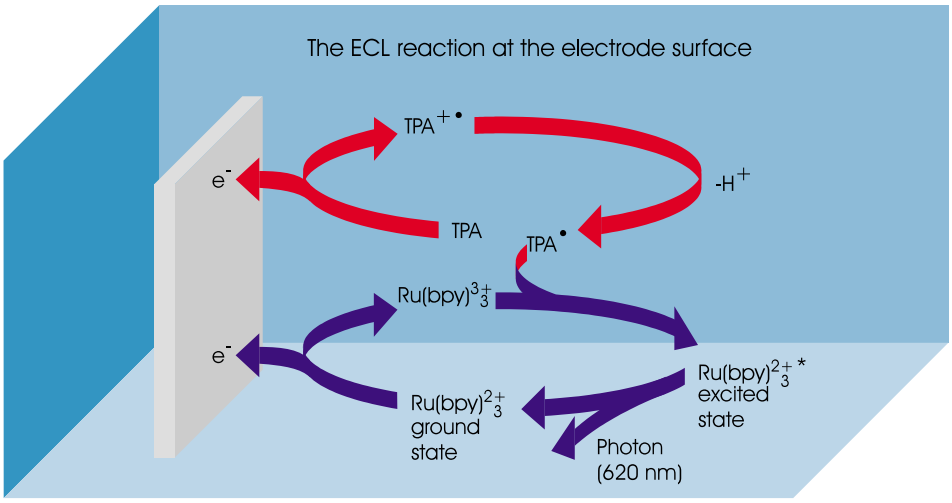


Detection of a ruthenium-labeled immune complex

Two electrochemically active substances, the ruthenium complex and tripropylamine (TPA), are involved in the reactions that lead to the emission of light. Both substances remain stable, as long as a voltage is not applied.

The ECL reaction of ruthenium tris(bipyridyl)$^{2+}$ and tripropylamine occurs at the surface of a platinum electrode. The applied voltage creates an electrical field, which causes all the materials in this field to react. Tripropylamine is oxidized at the electrode, releases an electron and forms an intermediate tripropylamine radical-cation, which further reacts by releasing a proton (H^+) to form a TPA radical (TPA•).

In turn, the ruthenium complex also releases an electron at the surface of the electrode thus oxidizing to form the [$Ru(bpy)_3^{3+}$] cation. This ruthenium cation is the second reaction component for the following chemiluminescent reaction with the TPA radical.



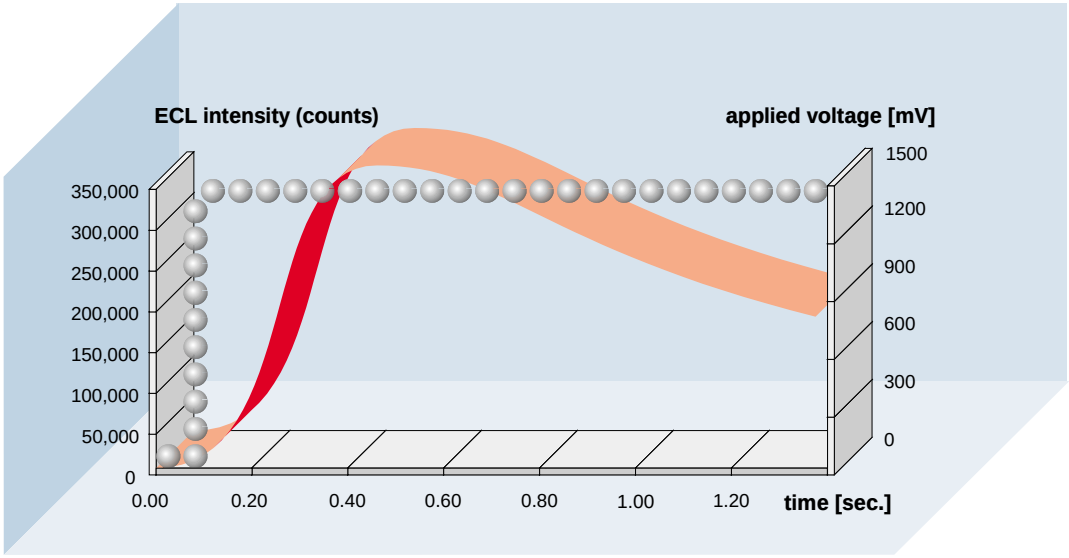
The ECL reaction at the electrode surface

TPA• and $Ru(bpy)_3^{3+}$ react with one another, whereby $Ru(bpy)_3^{3+}$ is reduced to $Ru(bpy)_3^{2+}$ and at the same time forms an excited state via energy transfer. This excited state is unstable and decays with emission of a photon at 620 nm to its original state. The reaction cycle can now start again. The tripropylamine radical reduces to by-products which do not affect the chemiluminescent process. TPA is used up and therefore must be present in excess. The reaction is controlled by diffusion of the TPA and the amount of ruthenium complex present. As TPA in the electrical field is depleted, the signal strength (light) is slowly reduced once the maximum is reached.

Although during measurement, TPA is used up, the ruthenium ground state complex is continually regenerated. This means that the ruthenium complex can perform many light-generating cycles during the measurement process, therefore showing an inherent amplification effect which contributes to the technology's sensitivity. Many photons can be created from one antigen-antibody complex.

ECL Signal Generation

The graph displays a typical ECL signal generation. Viewed from an electrical perspective, the reaction can be explained as follows: When a voltage is applied to the detection cell electrode, a peak of light emission occurs over a short time interval and can be detected as the resulting ECL signal. A defined area under the curve is measured around the intensity maximum.



ECL signal generation

The dotted line indicates the voltage at the electrode used to generate the ECL signal. The solid line is the actual light output measured by the photomultiplier detector.

ECL Measuring Cell

The core of the system is the ECL detection cell, which is designed as a flow-through cell. Essentially, three operating steps are performed in the measuring cell:

- **Bound/Free Separation**

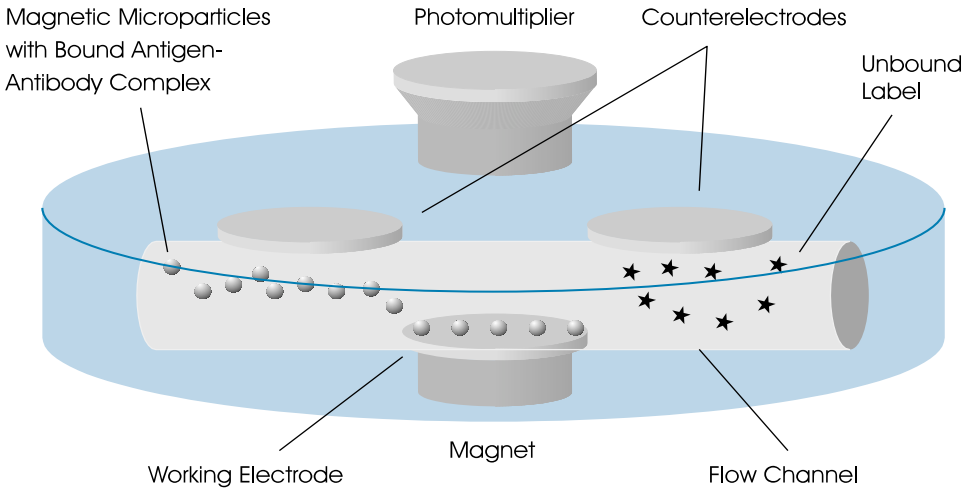
  Using a magnet, the streptavidin microparticles that are coated with antigen-antibody complexes, are uniformly deposited on the working electrode. A system buffer (ProCell) is used to wash the particles on the working electrode and to flush out the excess reagent and sample materials from the measuring cell.

- **ECL Reaction**

  The magnet is removed and a voltage is then applied to the electrode on which the microparticles, coated with antigen-antibody complexes, are deposited to initiate the ECL reaction. The light emission is measured with a photomultiplier. The system then uses the corresponding signals for the calculation of results.

- **Release of Microparticles and Cell Cleaning**

  Once the measurement is completed, the paramagnetic microparticles are washed away from the electrode surface with a special cleaning solution (CleanCell). The surface of the measuring cell is regenerated by varying the potential on the electrode. The cell is then ready for another measurement.

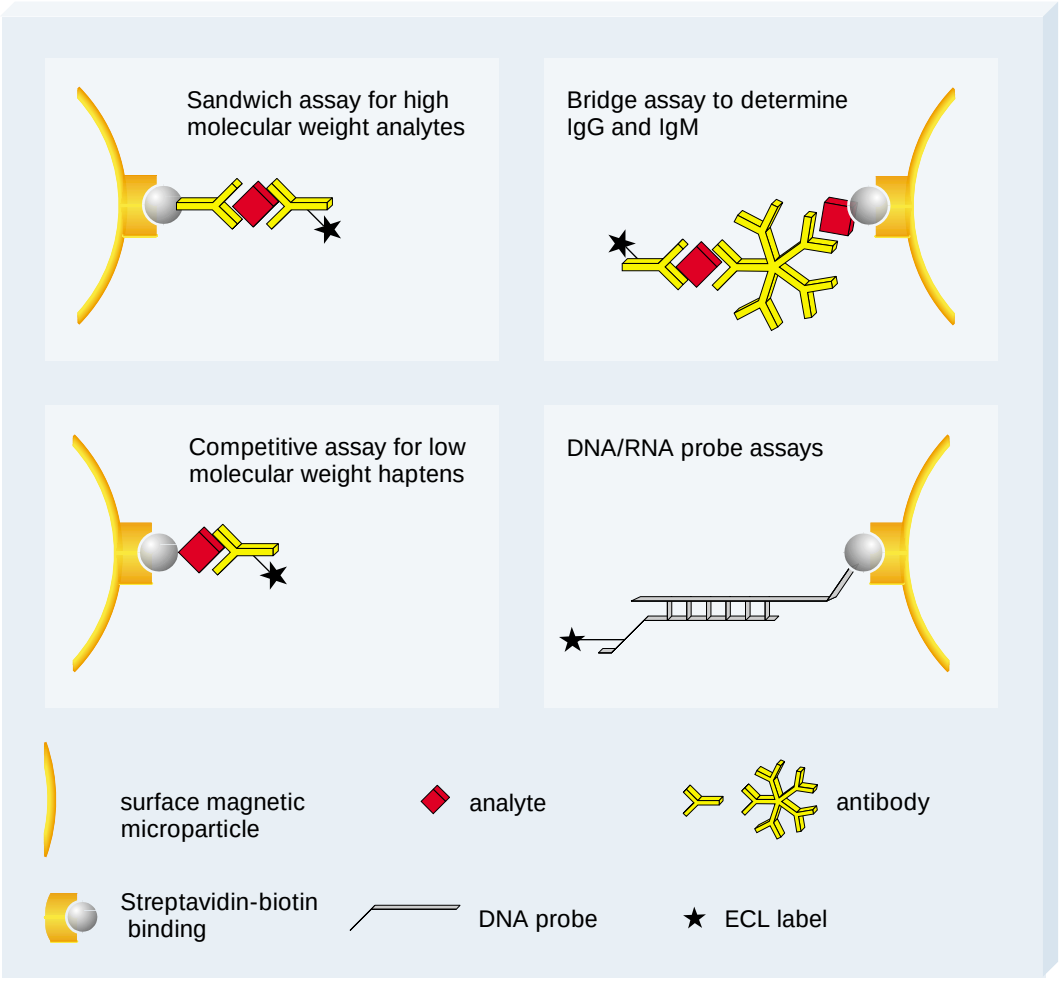


ECL measuring cell

Advantages of ECL Technology

Electrochemiluminescence is a highly innovative technology that offers distinct advantages over other detection techniques.

- Extremely stable non-isotopic label allows liquid reagent convenience.
- Enhanced sensitivity in combination with short incubation times means high quality assays and fast result turnaround.
- Large measuring range of five orders of magnitude minimizes dilutions and repeats, reducing handling time and reagent costs.
- Applicable for the detection of all analytes providing a solid platform for menu expansion.



ECL assay types

5. Test Principles for Immunoassays

5.1 Test Principles

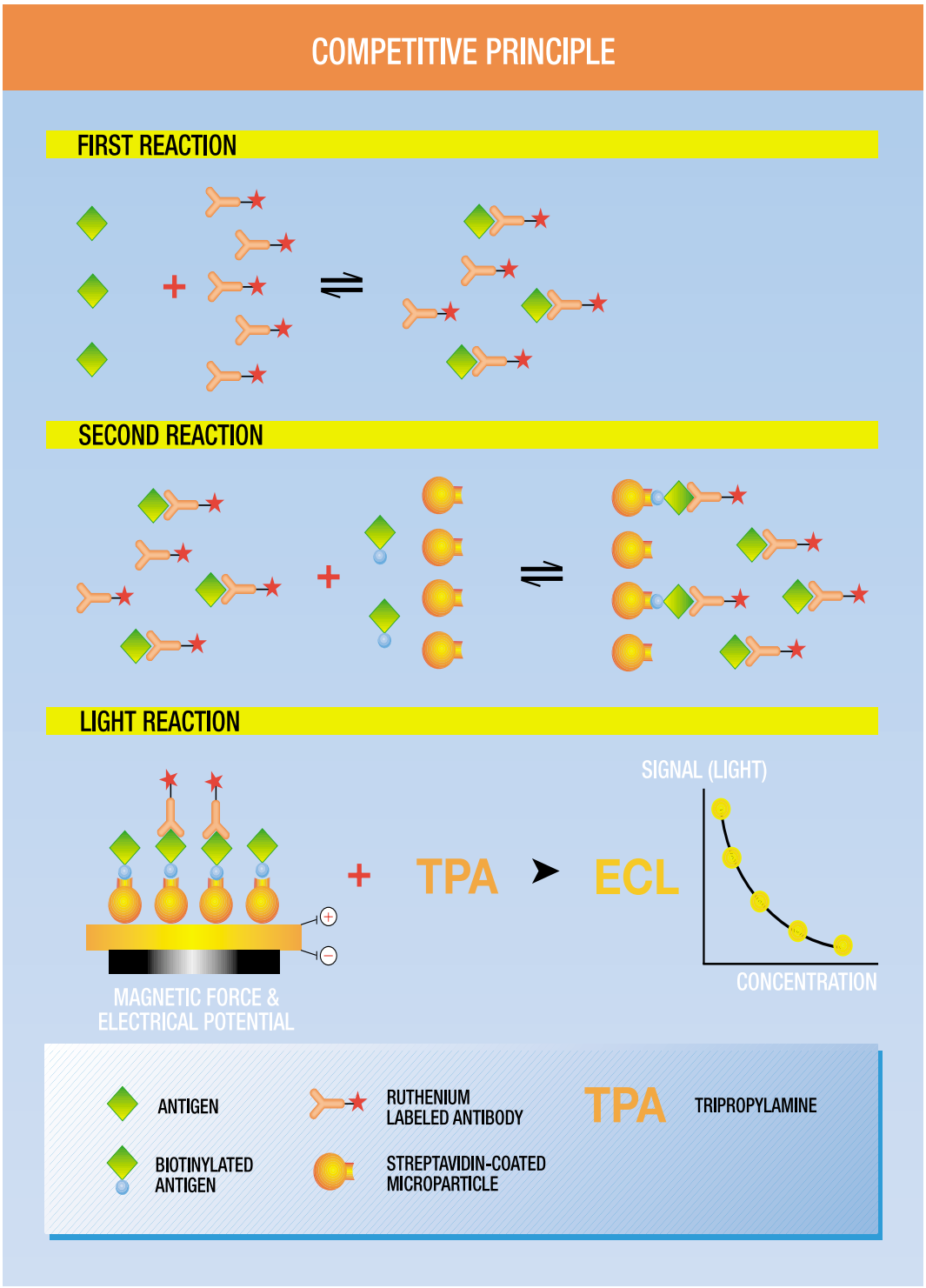
Three test principles are available on the Elecsys 1010 analyzer: competitive principle for extremely small analytes, sandwich principle (one or two steps) for larger analytes and a bridging principle to detect antibodies in the sample.

5.1.1 Competitive Principle

This principle is applied to analytes of low molecular weight, such as FT3.

- In the first step, sample and a specific anti-T3 antibody labeled with a ruthenium complex are combined in an assay cup.
- After addition of biotinylated T3 and streptavidin-coated paramagnetic microparticles, the still free binding sites of the labeled antibody become occupied with formation of an antibody-hapten complex. The entire complex is bound to the microparticle via interaction of biotin and streptavidin.
- After the second incubation, the reaction mixture containing the immune complexes is transported into the measuring cell. The immune complexes are magnetically entrapped on the working electrode, but unbound reagent and sample are washed away by ProCell.
- In the ECL reaction, the conjugate is a ruthenium-based derivative and the chemiluminescent reaction is electrically stimulated to produce light. The amount of light produced is indirectly proportional to the amount of antigen in the patient sample.

Evaluation and calculation of concentration of the antigen are carried out by a calibration curve established using standards of known antigen concentration.

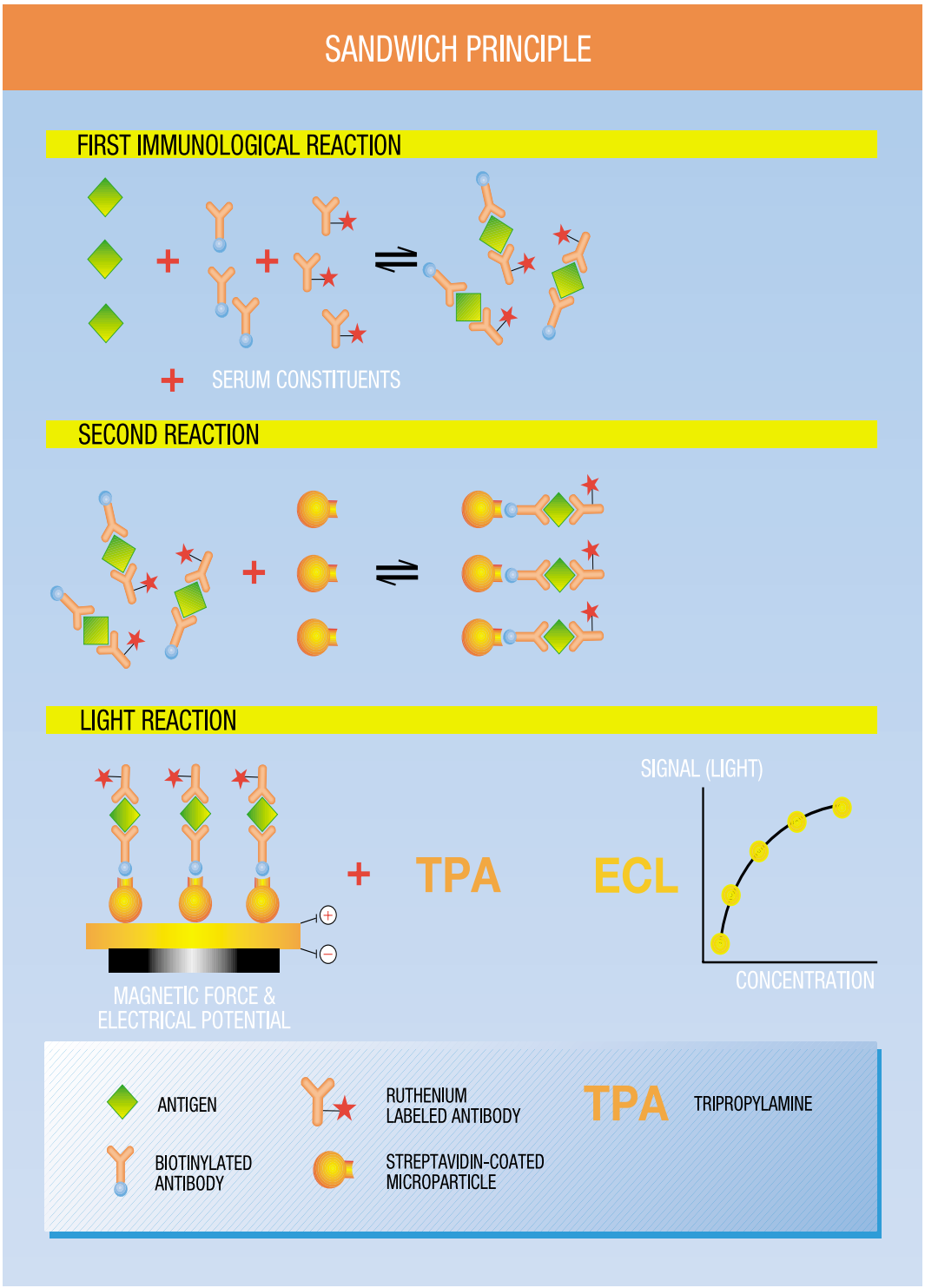

COMPETITIVE PRINCIPLE
FIRST REACTION
SECOND REACTION
LIGHT REACTION
TPA
ECL
SIGNAL (LIGHT)
CONCENTRATION
MAGNETIC FORCE &
ELECTRICAL POTENTIAL
ANTIGEN
BIOTINYLATED
ANTIGEN
RUTHENIUM
LABELED ANTIBODY
STREPTAVIDIN-COATED
MICROPARTICLE
TPA
TRIPROPYLAMINE

5.1.2 Sandwich Principle

The sandwich principle is applied to higher molecular weight analytes, such as thyroid-stimulating hormone (TSH).

- In the first step, the patient sample is combined with a reagent containing biotinylated TSH antibody and a ruthenium-labeled TSH-specific antibody in an assay cup. During a nine-minute incubation step, antibodies capture the TSH present in the sample.
- In the second step, streptavidin-coated magnetic microparticles are added. During a second nine-minute incubation, the biotinylated antibody attaches to the streptavidin-coated surface of the microparticles.
- After the second incubation, the reaction mixture containing the immune complexes is transported into the measuring cell; the immune complexes are magnetically entrapped on the working electrode, but unbound reagent and sample are washed away by ProCell.
- In the ECL reaction, the conjugate is a ruthenium-based derivative and the chemiluminescent reaction is electrically stimulated to produce light. The amount of light produced is directly proportional to the amount of antigen in the sample.

Evaluation and calculation of concentration of the antigen or analyte are carried out by a calibration curve established using standards of known antigen concentration.

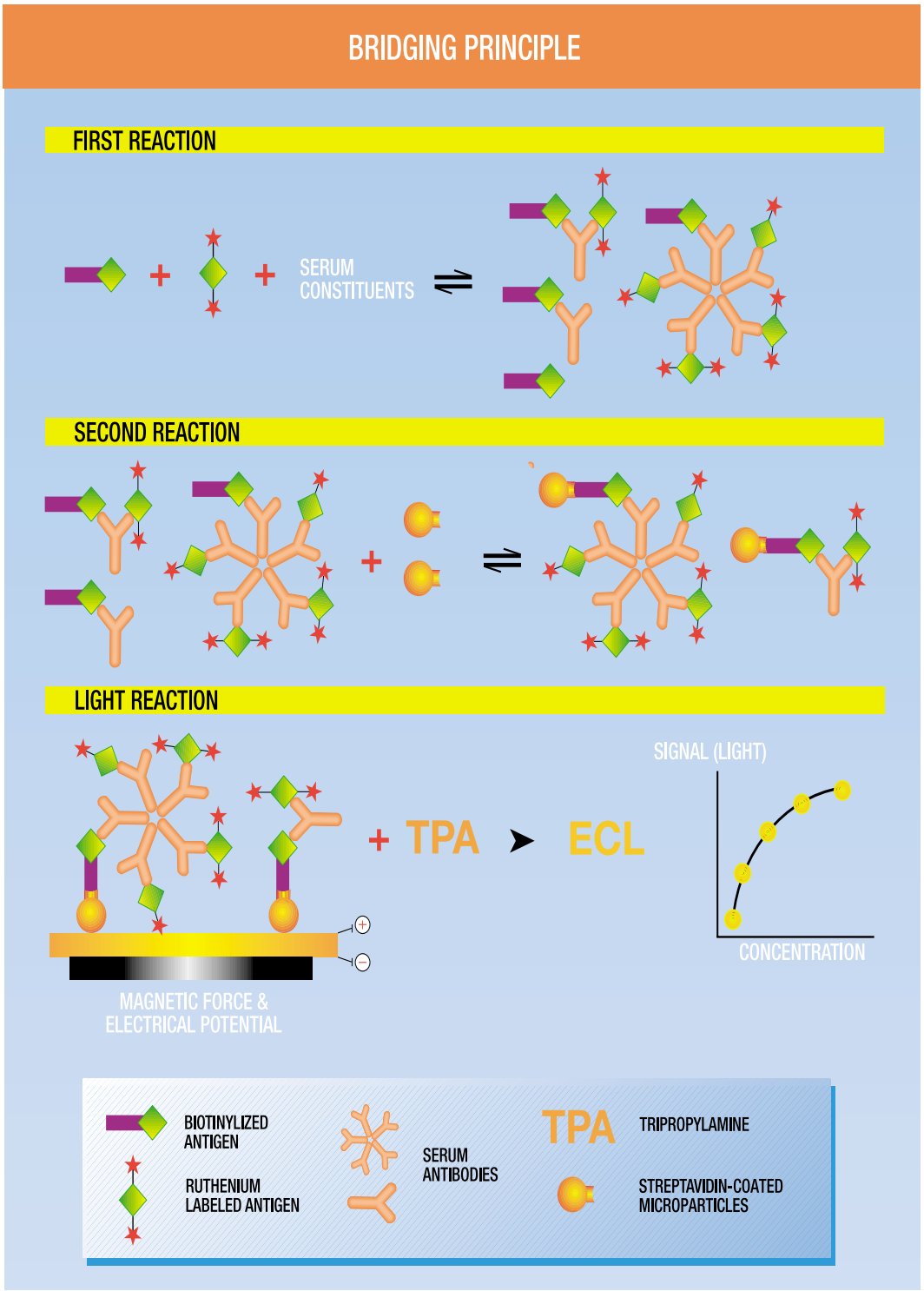

SANDWICH PRINCIPLE
FIRST IMMUNOLOGICAL REACTION
SERUM CONSTITUENTS
SECOND REACTION
LIGHT REACTION
TPA
ECL
SIGNAL (LIGHT)
CONCENTRATION
MAGNETIC FORCE &
ELECTRICAL POTENTIAL
ANTIGEN
BIOTINYLATED
ANTIBODY
RUTHENIUM
LABELED ANTIBODY
STREPTAVIDIN-COATED
MICROPARTICLE
TPA
TRIPROPYLAMINE

5.1.3 Bridging Principle

The bridge principle is similar to the sandwich principle, except that the assay is designed to detect antibodies, not antigens, (e.g., IgG, IgM and IgA). This is accomplished by including biotinylated and ruthenium-labeled antigens in the reagents for which the targeted antibody has affinity.

- In the first step, serum antibodies bind with the biotinylated and ruthenium-labeled antigens to form an immune complex.
- The immune complex then reacts with streptavidin-coated microparticles via the biotinylated antigen.
- After the second incubation, the reaction mixture containing the immune complexes is transported into the measuring cell; the immune complexes are magnetically entrapped on the working electrode, but unbound reagent and sample are washed away by ProCell.
- In the ECL reaction, the conjugate is a ruthenium-based derivative and the chemiluminescent reaction is electrically stimulated to produce light. The amount of light produced is directly proportional to the amount of analyte in the sample.

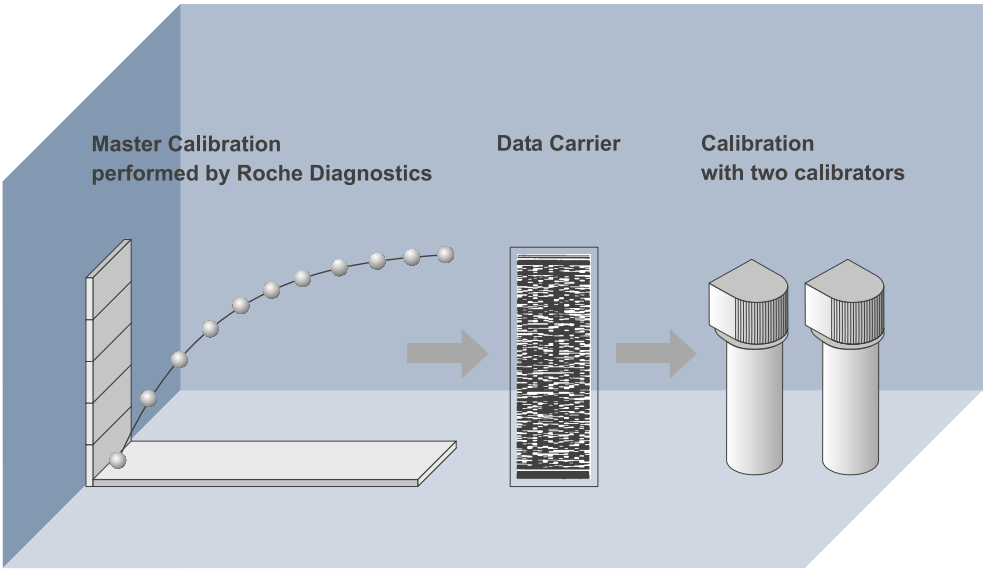
Evaluation and calculation of the concentration of the antibody are carried out by a calibration curve established using standards of known antibody concentrations.


BRIDGING PRINCIPLE
FIRST REACTION
SERUM CONSTITUENTS
SECOND REACTION
LIGHT REACTION
+ TPA
ECL
SIGNAL (LIGHT)
CONCENTRATION
MAGNETIC FORCE & ELECTRICAL POTENTIAL
BIOTINYLIZED ANTIGEN
RUTHENIUM LABELED ANTIGEN
SERUM ANTIBODIES
TPA
TRIPROPYLAMINE
STREPTAVIDIN-COATED MICROPARTICLES

6. Calibration

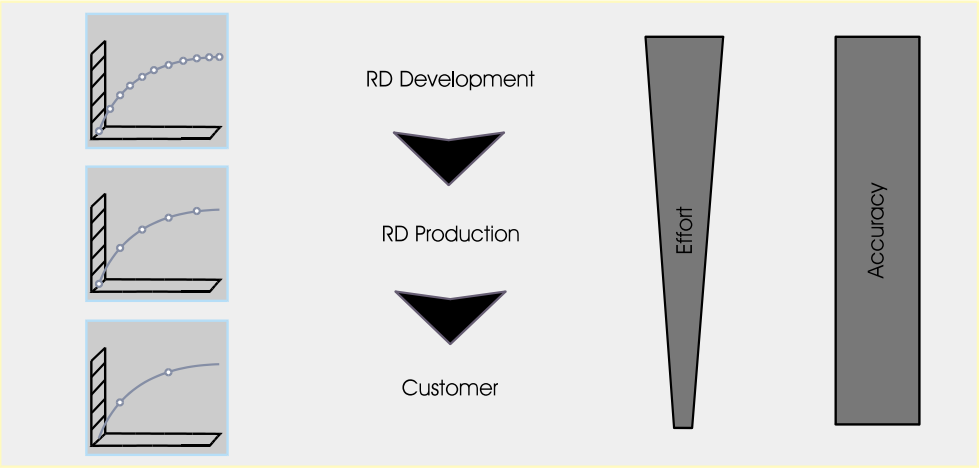
6.1 Introduction

Calibrations are performed to determine the exact concentration of unknown substances. This allows a result to be determined as accurately as possible independent of the reagent lot, reagent conditions and the analysis system. Roche Diagnostics produces a master calibration curve during production of the reagent that is then encoded in the 2D bar code of the relevant reagent pack. This information is then transferred to the Elecsys 1010. This master calibration curve is then updated by measuring two calibrators under routine laboratory conditions.



The calibration curve produced from the bar-coded master calibration and the measured calibration results refer to a specific reagent lot and in some cases to a specific reagent pack. The result of the calibration is automatically validated by the analyzer and can then be assessed by the operator.

6.2 Calibration Concept of Elecsys



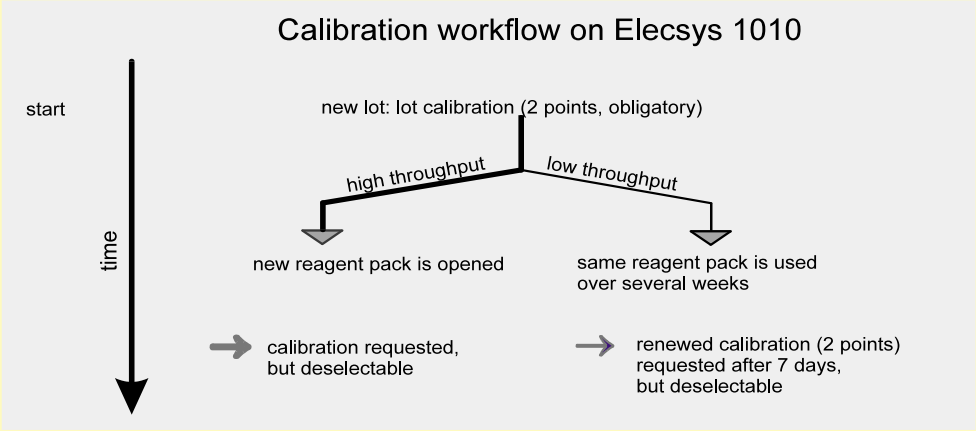
Roche Diagnostics produces a reference curve using special master reagent packs and certified reference standard material (e.g., from the World Health Organization, WHO). The curve is based on 10 to 12 measurement points and is the basis for the production of master calibrators.

In a second step, Roche Diagnostics produces a test-lot-specific master calibration using a lot-specific reagent pack and 5 to 6 master calibrators. The shape of this lot-specific master curve is described by the four parameters of the Rodbard function. The curve information is stored in the reagent bar code. The lot-specific calibrator assigned values (i.e., CalSet assigned values) are read from the master calibration curve and are encoded on the CalSet calibrator card.

In the laboratory, the calibration results from two calibrators that were measured under routine conditions are mathematically combined with the encoded data from the 2D bar code. From this combination, Elecsys 1010 determines the test and lot-specific calibration curve with which the concentration of measured samples is reliably calculated.

6.3 Laboratory Calibration

Elecsys 1010 automatically considers all calibration requirements and informs the operator by on-screen messages when a calibration is required or recommended.


Calibration workflow on Elecsys 1010
start
time
new lot: lot calibration (2 points, obligatory)
high throughput
low throughput
new reagent pack is opened
same reagent pack is used over several weeks
calibration requested, but deselectable
renewed calibration (2 points) requested after 7 days, but deselectable

Calibration Recommendations

Tests must be calibrated in the following cases, otherwise a run using the corresponding test is not possible:

- When a reagent pack from a new reagent lot is used.
- When a calibration status is not available for the test. This occurs, for example, after the detection unit has been replaced.
- When the operator has set the software so that a calibration is required for the test in each run. This setting can be changed in the CALIBRATION EVERY RUN field in UTILITIES, TEST CONDITIONS.
- When the operator has set the software so that a calibration is required for every new reagent pack. This setting can be changed in the CALIBRATE NEW REAGENT PACK field in UTILITIES, TEST CONDITIONS.
- When the operator has set the software so that a PERIODIC CALIBRATION is required at a fixed interval (7 days) and the interval has expired. This setting can be selected in the field in UTILITIES, TEST CONDITIONS.

In the following cases, a calibration is recommended:

- A new reagent pack of an already calibrated lot is used.
- The calibration interval (e.g. 7 days) on the 2D bar code of the reagent pack has expired. The calibration suggested by the analyzer can, however, be deselected in the CALIBRATION ORDERS screen. If available, existing valid calibration values can be used for the corresponding test.

For assay specific calibration recommendations, refer to the package insert or product information sheet.

Note

A detailed description about the handling of calibrators, as well as the screen displays, can be found in the Tutorial Guide, Chapter 2.7, Calibrations.

6.4 Stability of Calibrations on Elecsys 1010

Elecsys 1010 stores three types of calibration curves.

Lot Calibration

Each new test lot must be calibrated before it is used. Elecsys 1010 determines a valid lot-specific calibration curve for the test from this initial calibration. A total of 60 calibration curves of this type can be stored in the system. Normally, each new calibration (released by Elecsys 1010) of a new reagent pack for this test lot overwrites the oldest lot-specific calibration curve. Therefore, if a calibration does not conform to the validation criteria, a current lot-specific calibration curve can be used. One exception to this process is the calibration of a new reagent pack, when the time between the initial scanning of the reagent pack and the start of the calibration is greater than 24 hours. Calibration of such reagent packs provides a calibration curve that is valid only for this reagent pack.

Reagent Pack Calibration

Reagent pack calibration curves are produced as soon as a used reagent pack is re-calibrated (e.g. after one week). This calibration curve is stored along with the lot-specific curve and is used exclusively for the calculation of results for this reagent pack. In addition to the lot-specific calibration curve, Elecsys 1010 can also store up to 60 reagent pack calibration curves. As soon as a reagent pack is empty, the corresponding reagent pack calibration is automatically deleted, if present.

Run-Specific Calibration

Calibrations that can be manually changed are valid only for the calculation of sample results for the current run. For the next run, the system uses either the reagent or lot-specific calibration curve.

6.5 Automatic Validation of Calibrations

Elecsys 1010 validates every calibration automatically. The following checks are considered:

- Completeness of the calibration
- Monotony
- Within specific calibration signal ranges
- Within specific maximum signal deviations for multiple determinations

If a calibration fulfills all conditions, the calibration curve will be automatically released by the system and will be used to determine the sample concentrations.

The CALIBRATION RESULTS screen displays the calibration results and allows manual changes where necessary.

Note

Refer to the Tutorial Guide, Chapter 2.8, Calibration Results, to see how calibrations are validated.

The validation criteria are listed in detail in the following tables.

CALIBRATION RESULTS Screen	Validation Criteria	Description
Released by operator	Valid calibration. All values are present and are within the required minimum signal range. The calibration fulfills all the criteria that are listed in the Introduction of Section 6.5 in Reference Guide.	The curve is released by the system and is used to calculate sample and control results.
Blocked	Incomplete duplicate determination. Every calibration is measured in duplicate determination. One of the measured values is not available.	The calibration curve is blocked, it can however be released by the operator. If there is a curve from the last calibration available in the system, it is recommended that this is used. The calibration is valid only for this run.
	Results with a flag. Example: Temperature outside target range.	The calibration is blocked. Under certain circumstances, manual release is possible, if required, by blocking an individual result. The result is given a flag. The calibration is only valid for this run. It is recommended that the curve of the last calibration is used or that a new calibration is performed.

CALIBRATION RESULTS Screen	Validation Criteria	Description
Blocked	The signals of a duplicate determination are too far apart.	The calibration curve is blocked. The calibration can be released by the operator or one of the signal results can be blocked and then the calibration can be manually released. If there is a curve from the last calibration available in the system, it is recommended that this is used. The calibration is valid only for this run.
	Qualitative tests: The signals of both cutoff calibrators are too close together.	The calibration is blocked. The calibration can be released by the operator or one of the signal results can be blocked and then the calibration can be manually released. If there is a curve from the last calibration available in the system, it is recommended that this is used. The calibration is valid only for this run.
	One calibration signal is outside the minimum/maximum range.	The calibration curve is blocked. The calibration can be released by the operator or one of the signal results can be blocked and then the calibration can be manually released. If there is a curve from the last calibration available in the system, it is recommended that this is used. The calibration is valid only for this run.
	The calibration did not produce a monotony curve or the slope of the curve is incorrect.	The calibration is not valid, the curve is blocked and cannot be released. Under certain circumstances, a signal can be blocked. Subsequently, it may be possible to release the curve. It is recommended that the curve of the last calibration is used or that a new calibration is performed.

6.6 Calibration of Quantitative Assays

The following is a description of the different methods utilized by the Elecsys 1010 analyzer for calculating results. To calculate quantitative tests, the 1010 utilizes the following three calibration functions to convert measured signals into concentrations:

- Rodbard function
- Linear calibration function
- Linear-reciprocal calibration function.

The calibration function used by the system is encoded in the 2-dimensional bar code on the appropriate reagent pack. The calculations are performed automatically by the analyzer, including the correction for samples diluted by the analyzer.

Rodbard Function

The conversion of the measured signal into a concentration using the Rodbard function is as follows:

$$y = \frac{a - d}{1 + \left(\frac{x}{b}\right)^c} + d$$

y	=	Signal
a, b, c, d	=	Rodbard function parameters
x	=	Sample concentration

Parameters b and c define the shape of the curve and parameters a and d define the position of the curve.

Thanks to the precise automation on the analyzer, the shape of the calibration curve is very stable and, therefore, it is possible to calibrate this nonlinear Rodbard function with only two calibrators and the information of the shape parameters b and c. The curve position parameters a and d are calculated with each calibration. Such a calibration is called 2-point calibration.

The following inverse formula is used to determine the unknown's concentration based on its signal.

$$x = b \cdot \left(\frac{a - y_2}{y_2 - d}\right)^{\frac{1}{c}}$$

y	=	Signal
a, b, c, d	=	Rodbard function parameter
x	=	Sample concentration

Linear Calibration Function

The conversion of the measured signal into a concentration is as follows:

$$y = b \cdot x + a$$

y = Signal
x = Concentration
a, b = Calibration curve parameter (y-intercept and slope)

Calibrations using a linear calibration curve are always performed using two calibrators.

The following inverse formula is used to determine the unknown's concentration based on its signal.

$$x = \frac{y - a}{b}$$

x = Sample concentration
a, b = Calibration curve parameter
y = Signal

Linear Reciprocal Calibration Function

The conversion of the measured signal into a concentration is as follows:

$$\frac{1}{y} = b \cdot x + a$$

y = Signal
x = Concentration
a,b = Calibration curve parameter (y-intercept and slope)

Calibrations using a linear reciprocal calibration curve are always performed using two calibrators.

The following inverse formula is used to determine the unknown's concentration based on its signal.

$$x = \frac{1 - ay}{by}$$

x = Sample concentration
a, b = Calibration curve parameter
y = Signal

Glossary

Numbers

2-dimensional bar code	(2D) type of bar code found on the reagent pack, calibrator and control bar code cards. Utilizes PDF417 symbology.This bar code contains more information than traditional linear bar codes.

A

analytical sensitivity	the lower detection limit of the assay. The analytical sensitivity represents the lowest analyte concentration that can be distinguished from zero. It is calculated as the concentration two standard deviations above the lowest standard used in the master calibration. Since the master calibration is performed by Roche Diagnostics, it is not possible for the customer to verify the sensitivity exactly as it was performed at Roche Diagnostics. Cal 1 was not used to determine analytical sensitivity. Master calibration standards were used.
analyzer unit	the analyzer unit consists of the sample/reagent area, consumables area, measuring area and power switch.
assay	• a specific test. • the process of measuring a substance.
assay cup (or cup)	clear plastic cup used to hold the assay reaction mixture. Cups are configured in segments that contain 32 cups each.
assigned values	the assigned value for a calibrator (Cal 1 or Cal 2) is encoded on the calibrator bar code card.
automatic positioning	this mode is used when working with non-barcoded samples and the host download is without position numbers. Downloaded samples without positions are automatically assigned the next free positions.

B

bar code	a series of lines representing data encoded in a format containing information that can be automatically scanned. Bar codes used on the analyzer can either be linear or 2D.

bar code card	either a calibrator or control card. These cards contain either all assigned values (calibrator card) or target values and ranges (control card) for assays.
bar code card holder	slot located in each reagent pack position on the S/R disk where the bar code cards are scanned.
bar code reader	the device that reads the code from a sample, reagent bar code label, bar code card or calibrator vial.
BlankCell	reagent pack used to perform a BlankCell Procedure.
BlankCell procedure	procedure to maintain the sensitivity of the measuring cell and photomultiplier tube.
block	a result can be blocked by the operator or the system. A blocked result is printed or uploaded to the host with the appropriate flag. Block a result that is questionable and should be repeated.
bound/free separation	the physical separation of reagent and/or sample which is bound to a solid phase (i.e., microparticles) from free reagent and/or sample. This step occurs in the measuring cell.
bridging principle	one of three test principles available on the 1010 analyzer. It is used to detect antibodies in the sample (e.g., IgG, IgM or IgA).

C

calibration	the process to standardize the instrument with samples of known concentration. This process establishes factors and or updates baselines to enable conversion of the response of the instrument to concentration (or activity) for the constituent being measured.
calibration factor	one of the calibration quality criteria used to determine the outcome of a calibration. It is derived from the comparison of two different calibrations. A factor of 1.0 is produced if the two calibration are perfectly matched. Each Reagent pack calibration (R-Cal) is compared to the Lot calibration (L-Cal) to generate this factor. The remaining criterias are missing values, minimum signal, deviation of duplicate measurements and system errors. Note: The calibration factor does not appear in any screen or printout.

calibration frequency	the specified interval at which an assay must be calibrated. This frequency is found in reagent package inserts and in product informations.
calibration function	the type of calibration (e.g., Rodbard function, linear function, cutoff function).
calibration quality criteria	criteria applied to the automatic validation of every calibration on the analyzer.
calibration type	Lot calibration (L-Cal) or Reagent pack calibration (R-Cal) or Run calibration.
calibration validation	procedure performed by the analyzer software whereby a calibration data set is checked versus specific criteria encoded in the reagent bar code.
calibration verification	a procedure required by the United States Health Care Financing Administration (HCFA) and Clinical Laboratories Improvement Act (CLIA). "Calibration verification is the assaying of calibration materials in the same manner as patient samples to confirm that the calibration of the instrument kit or test system has remained stable throughout the laboratory's reportable range for patient test results."[1]
calibrator	a substance with known concentrations used in the calibration of immunoassays.
capacitance	used in liquid level detection in the S/R probe and sipper probe. The probes carry a high frequency low voltage electrical charge. The frequency and electrical charge characteristics are altered and sensed when the probe touches liquid.
CapTwist	opener to aid in the manual removal of ProCell and CleanCell bottle caps.
CleanCell	reagent used to: • cleanse the tubing system and measuring cell after each measurement • condition the electrodes.
clot detection	used in the aspiration system of the S/R probe. As the appropriate volume of sample is aspirated, the release of vacuum is monitored by a vacuum/pressure transducer. If an abnormal vacuum is detected, a clot detection alarm is issued to notify you and the sample is not aspirated.

1. 42 United States Code of Federal Regulations. Part 493.1217. Standard; Calibration and calibration verification procedures.

competitive principle	one of three test principles available on the 1010 analyzer. It is used to detect analytes of low molecular weight (e.g., FT3, see description in Chapter 5).
consumables	items that are used during test processing and must be replaced on a regular basis by the operator (i.e., assay cups, printer paper, etc.).
consumables area	consists of four assay cup segments in the incubator, liquid waste container, distilled water container.
control	a substance with known values of analytes used to verify calibration and performance of immunoassays.
control ID	the abbreviated control name found in the software (e.g., PC U1 or PC TSH)
control name	the name of a control (e.g., PreciControl Universal).
control unit	the part of hardware that consists of the LCD display, menu keys, special keys, numeric keypad and the two STAT positions. There is the possibilty to connect an external keyboard with a 5-pin standard connector underneath at the right side of the control unit. The complete control unit is like a drawer. Pull out the control unit to access the two STAT positions.
cover	to start the instrument the cover must be closed. If the cover is opened during a run, the analyzer moves the probes and microparticle mixer into the rinse stations to prevent accidental contact. Therefore the run is stopped.
cup	see assay cup.
cycle	instrument time interval of 62 seconds.

D

data disk	see reference data disk.
data entry field	a field on the displayed screen where you can enter or edit information with the numeric pad or an external keyboard.
data field	a field on the displayed screen that contains information only. There is no user access.

detection unit	contains the photomultiplier tube, peltier, flow-through measuring cell, magnet drive assembly and an amplifier circuit board. The detection unit is the core of the 1010 analyzer.
deviation of duplicate measurements	one of the calibration quality criteria. For a calibration to be successful, replicate measurements must fall within a specific duplicate limit. The remaining criteria are missing values, minimum signal, deviation of duplicate measurements and system errors.
diluent	see universal diluent.
dilution factor	a software preset dilution ratio used by the analyzer to automatically perform a requested dilution. Recommended dilution factors are found in reagent package inserts and in product informations.
disk position	a position on the S/R disk. There are up to 66 sample positions and up to 6 positions for reagent packs on the disk.
dispense	delivery of a sample or reagent by the appropriate probe to an assay cup.
display	see control unit.
distilled water container	contains the distilled or deionized water supply for the analyzer. The four liter plastic bottle is located on the left side of the analyzer.
document	the process of printing a report for a sample which in turn transfers the sample results to the SAMPLE HISTORY (after a new scan). Documentation can also be done by uploading to host.
door	printer door. Provides access to printer paper or floppy disk drive.
download	the transfer of information (e.g., sample ID, test requests) from the host computer system to the 1010 analyzer.
DNA/RNA probe	a test principle that can be used on the 1010 analyzer. The DNA/RNA probe is for the detection of DNA or RNA molecules and is currently under development.

E

ECL	electrochemiluminescence. The detection technology used on Elecsys immunoassay analyzers.
error handling	process during which the analyzer attempts to recover from an error condition. If the analyzer cannot successfully recover from the error, an alarm is issued.
expected values	the values for an assay that should be recovered for a “normal” result. Also known as normal range or reference range.
extended dynamic range	the measuring range for an assay at its highest dilution.

F

first registration date	the date that the reagent pack was first successfully scanned by the bar code reader.
flag	an identifier used to call attention to a result. A flag is followed by a 4 digit number and a description of the error e.g. Flag 5161: Abnormal descent - sample. A detailed description of the flags is found in the User’s Guide.
floppy disk	(FD) a small plastic disk coated with magnetic material on which data from a computer can be stored.
floppy disk drive	holds the data disk. The drive is located behind the door of the internal printer.
functional sensitivity	concentration at which a particular level of imprecision is obtained.
function keys	perform functions that are the same in all menus or dependent upon the currently displayed menu. If a function cannot be performed, a corresponding message is issued.

H

host communication	information exchange with a laboratory information system (host computer).

I

incubator	an aluminum block maintained at 37 °C that accommodates 128 assay cups containing reaction mixture.
initialization	an instrument status condition that occurs when the analyzer is powered ON.
instrument alarms	displayed alarms that indicate abnormal instrument conditions (i.e., reagent disk temperature, mechanical malfunctions, etc.).
inventory control	real time monitoring of the actual amount of all consumable items on the analyzer.

L

Laboratory Information System	(LIS) external computer with appropriate software for data management (host computer).
Laboratory System Manager	(LSM) a common user interface for patient administration, sample ordering, validation and quality control in clinical chemistry and immunology.
linear bar code	traditional 1D bar code. Limited data capacity.
liquid level detection	(LLD) ability of the sample/reagent and sipper probes to sense liquid.
liquid waste container	contains liquid waste generated by the analyzer. The five liter plastic bottle is located in the front of the ProCell and CleanCell reagent compartments.
lot calibration (L-Cal)	a calibration performed with a fresh reagent pack that has been registered by the analyzer for less than 24 hours. The lot calibration is valid for all other reagent packs of the same lot, provided these reagent packs were stored as specified in the package insert or product information.
lower detection limit	(LDL) see analytical sensitivity.

M

master calibration	a reference standardization curve utilizing master test kit reagents and certified reference standard material [e.g., World Health Organization (WHO) reference material] measured at Roche Diagnostics. This curve uses 10 to 12 points. The reference standard curve is the basis for the production of master calibrators.
master curve	a lot-specific master calibration curve (n=5 or 6) measured at Roche Diagnostics using lot-specific test kit reagents and master calibrators. The shape of the lot-specific master curve is characterized by a four parameter rodbard function. The data characterizing this curve is stored in the lot-specific reagent bar code. Lot-specific calibrator assigned values (i.e., CalSet assigned values) are read from the lot-specific master calibration curve and encoded in the CalSet calibrator bar code card.
Material Safety Data Sheets	(MSDS) documents that list components of chemical solutions and precautions for the handling and disposal of the solutions.
mean	the average value of a set of numbers, used in quality control evaluations.
measuring cell	flow-through cell where result measurement takes place. The measuring cell is part of the detection unit.
measuring range	see reportable range.
message line	one line at the bottom of the display that shows the system status (i.e., current operating conditions) and one line at the top with screen names and actual time.
microparticle	paramagnetic streptavidin-coated microparticles are the solid phase used in the bound/free separation step of ECL.
microparticle mixer	paddle on the sample/reagent arm that thoroughly mixes the microparticle reagent to ensure resuspension prior to use.
minimum signal	one of the calibration quality criteria. Each calibrator replicate value must be greater than a designated minimum signal value for a successful calibration. The

	remaining criteria are missing values, monotony of curve, calibration factor, deviation of duplicate measurements and system errors.
missing value	one of the calibration quality criteria. No calibrator replicates may be missing for a successful calibration. The remaining criteria are monotony of curve, calibration factor, minimum signal, deviation of duplicate measurements and system errors.
monotony of curve	one of the calibration quality criteria. All measured calibrator values must fall in either ascending (sandwich or bridging principle) or descending (competition principle) order for a successful calibration. The remaining criteria are missing values, calibration factor, minimum signal, deviation of duplicate measurements and system errors.

N

note	a statement in the text called out to make the operator aware of specific information.
normal range	see expected values.

O

open request	orders for a sample that have not yet been performed.
operation	an instrument status condition that occurs when the analyzer is performing its routine operations.
ON/OFF switch	found on the left side of the analyzer. This switch is used to power the analyzer ON or OFF.
operator ID	a number used to identify different operators.
optimised batch sequence	this function selects sequence change for complementary tests. When this option is selected in the interface setup, the sequence in which the tests are processed is altered if complementary tests have been requested.
order (or request)	tests selected for a specific sample or control.

P

paramagnetic	used in reference to microparticles. Microparticles themselves do not exhibit magnetic properties, but are capable of becoming magnetic when in the presence of a magnet or magnetic field.
parameters	a set of criteria used to establish how an assay is performed. All parameters are encoded on the reagent bar code label and cannot be changed by the operator.
pending requests	partial results for a sample are available; while other tests have not yet been performed or completed.
photomultiplier	a photoemissive photoelectric tube that amplifies emitted photons from the ECL reaction and converts them into an electric signal.
photon	a quantum of electromagnetic energy having both particle and wave behavior. It has no charge or mass, but possesses momentum; it carries the light emitted from the ECL reaction.
pop-up window	a window containing additional information that “pops up” within existing screens.
positive displacement	water in the pipettor that is displaced by the plunger during an aspirate/dispense cycle. Is equal to the amount of sample/reagent that is aspirated/dispensed by the probe.
ProCell	reagent used to: • condition the electrode • transport the assay reaction mixture • wash the streptavidin-coated microparticles • generate signal.
printer	the internal printer of the analyzer is a thermal printer. All results and some screen information could be printed out. An external printer can also be connected.

Q

qualitative assay	a determination of a substance without regard to quantity.
quality control	see control.

quantitative assay	a determination of a substance with regard to a specified number or amount.
questionable calibration	a calibration that does not successfully pass the calibration quality criteria. The curve may be manually released or rejected by the operator.

R

reaction mixture	sample combined with reagents in the assay cup. This final mixture is aspirated into the measuring cell.
reagent disk	see S/R disk.
reagent pack	reagent used on the Elecsys analyzer. It is composed of three physically connected bottles (R1, R2 and Microparticles). The components of a reagent pack cannot be interchanged with another reagent pack.
reagent pack calibration (R-Cal)	A reagent pack calibration is performed when reagent has been on the analyzer for more than 24 hours or when generated by an operator-released calibration. A reagent pack calibration is valid for one specific reagent pack only. The reagent pack calibration is compared to the most recent stored L-Cal for validation.
reagent pack number	the unique number on the reagent bottle label that identifies each reagent pack.
real time	display of information on the monitor at the moment a change which alters information occurs.
reportable range	the range of which results can be reported for the assay. It is from the lower detection limit to the maximum of the master calibration curve.
request (or order)	tests selected for a specific sample or control.
result	signal converted into concentration or a cut-off index for the assay selected. A result is generated for each test performed.
rinse station	rinses the mixer or probe externally with deionized water. Two rinse stations exist for the sample/reagent probe, one for the mixer and one for the sipper probe.

Rodbard function	a calibration function used by the analyzer to convert measured signals into concentrations. It utilizes four parameters; two of which define the shape of the curve and the other two define the position of curve.
ruthenium	a rare metallic chemical element of the platinum group that is utilized in electrochemiluminescent reactions.
ruthenium complex	$[Ru(byp)_3^{2+}]$ N-hydroxysuccinimide (NHS) ester. The complex is used for the development of light in ECL reactions.

S

sample disk position	see disk position.
sample ID	the identifier for the sample. It may be up to 22 characters (alphanumeric).
sample/reagent arm	(S/R arm) the rotational moving arm that holds the sample/reagent probe and microparticle mixer.
sample/reagent disk	(S/R disk) patient samples, reagent, diluents, calibrators and controls are loaded on the S/R disk.
sample/reagent pipettor	(S/R pipettor) it is filled with deionized water and uses positive displacement to aspirate and dispense from the sample/reagent probe.
sample/reagent probe	(S/R probe) mounted on the sample/reagent arm. It has a special coating in order to reduce sample/reagent carry-over. The S/R probe is part of the liquid level detection system (LLD).
sandwich principle	one of three test principles available on the 1010 analyzer. It is used to detect higher molecular weight analytes (e.g., TSH).
scan	process to read the bar code information into instrument memory.
SD	standard deviation, statistic used as a measure of the dispersion or variation in a distribution, equal to the square root of the arithmetic mean of the squares of the deviations from the arithmetic mean.
select	to mark an item so that a subsequent action can be performed on that item.

sequence number	a number from 1 to 9999. This number is automatically assigned to each sample by the analyzer and is used to track orders.
signal	the emission of light converted into an electric signal, which is in turn converted into an analyte concentration.
sipper arm	arm where the sipper probe is located.
sipper probe	probe that aspirates reaction mixture into the measuring cell. This probe also aspirates ProCell and CleanCell.
sipper pipettor	located directly to the right of the sample/reagent pipettor. It is filled with deionized water and uses positive displacement to aspirate from the sipper probe.
soft keys	provides additional selction options within a screen. The functions differ from screen to screen and are displayed by a text field on the screen.
special keys	keys for special functions like the navigation of the cursor, the ENTER key, C (clear), the plus and minus key and the UNDO key.
S/R arm	see sample/reagent arm.
S/R disk	see sample/reagent disk.
S/R pipettor	see sample/reagent pipettor.
standard	traceable reference material solutions used to create the master calibration curve.
stand-by	status condition that exists when the analyzer is not performing any operations.
STAT sample	(Short Turn Around Time) a sample that requires rapid turnaround.
status	• one of many instrument status conditions • one of many operation status
stop	function key which stops immediately the operation of the analyzer at any time without a second confirmation.
system errors	a hardware error that occurred during a operation.

T

target range	the specified limits of a control range for an assay.

target value	the mean value of the control target range for the assay.
temperature controlled	the temperature in a compartment is held stable within a specified range. The temperature is controlled with peltier units.
test	see assay.
test code	the abbreviated name for a test. This code appears on the test buttons within the software.
test principle	one of three principles used to detect analytes on the analyzer. These include competition, sandwich and bridging.
test protocol	an exact sequence of test steps used to perform an assay. These test steps include pipetting sample, reagent, incubating the reaction mixture for a specified time, etc.
tripropylamine	(TPA) one of two electrochemically active substances used in the ECL reaction. TPA acts with the ruthenium complex to initiate the light generating cycle which results in the emission of a photon.

U

unit of measure	assays are measured in certain concentration units. The analyzer has designated unit of measure for the analytes. This information is contained in the reagent bar code and is changeable in the UTILITIES, TEST CONDITION.
universal diluent	reagent used to dilute samples that exceed the reportable range of the assay.
upload	the sending of information (e.g., sample ID, test results, etc.) from the analyzer to the host computer.

W

warning	• a statement called out in this manual to make the operator aware of conditions that could cause damage to the analyzer or could cause personal injury. • an instrument alarm level that does not interrupt operation.
waste	anything discarded by the analyzer. It could be liquid waste or solid waste (cups).